JUN 1 1925

May 28, 1925

# Engineering News-Record

Devoted to Civil Engineering and Contracting

McGraw-Hill Company, Inc.

Exchequer Dam, Merced Irrigation District, California

## Exchequer Dam Construction Plant Built in a Narrow Canyon

## Flow of Water in Tulsa Concrete Pipe Line

*Also:* Several Short Articles including a number of "Job and Office" Hints

# Fireproofness

SAFETY!—Protection to the occupants of public buildings is the tremendous responsibility of architects, contractors and builders. Fire is the outstanding hazard. It, above all things, must be prevented.

On hundreds of public buildings of all kinds as well as on every type of industrial structure, Federal Cement Tile have been used because of their inherent fireproofness.

Made in a modern plant on a production basis, under close inspection and supervision, Federal Cement Tile are absolutely uniform. They are made in four styles, for all pitched, and flat surfaces: interlocking, glass insert, channel and flat slabs.

*Made, laid and guaranteed by*

FEDERAL CEMENT TILE CO.
608 S. Dearborn St., Chicago

Wyandotte School, Wyandotte, Mich., covered with Federal channel tile.

# FEDERAL Cement Tile

*"The Roof for Permanence"*

ENR5-28I-BTG

A Consolidation of Engineering News, Engineering Record and The Contractor

# ENGINEERING NEWS-RECORD

McGraw-Hill Company, Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
*Editor*

Volume 94 NEW YORK, MAY 28, 1925 Number 22

## Construction Legislation

LEGISLATION affecting construction, it is estimated, was provided in one bill in ten considered by state legislatures last winter. The count has been made by the Associated General Contractors. It cannot be verified at the moment but even if it were materially in error the total of bills relating to construction would be formidable. It was a rare state legislature last winter that did not consider 200 new bills and from five to ten times that number were considered by many. The bills were not all unfavorable to construction; many were advantageous and some were eagerly supported by contractors. The significance of the record is rather its indication of the active inclination to hedge construction about with legal restrictions. Indeed contractors themselves have for a few years been not any too loath to go to the legislatures for succor from their business troubles. Recrimination aside, however, there is a live danger of burying the construction business under too many laws. Except also for the vigilance and influence created in the last few years by organization, contractors would have no chance to stem the tide of lawmaking that has arisen. These two facts need to be held closely in mind.

## *C* Above 150

TESTIMONY of an achievement in conduit design and construction is recorded in Mr. Scobey's article on flow tests of the Tulsa conduit elsewhere in this issue. Values of *C* above 150 in the Hazen-Williams formula are shown for a 60-in., and above 145 for a 54-in. stretch of the conduit. The highest value of *C* was 152.4 for 15.3 miles of nearly straight 60-in. pipe. These results, like those on the 36-in. concrete pipe line for Norfolk, Va., after three years of service (see *Engineering News-Record*, March 12, 1925, p. 446) deserve the attention of all engineers who have water conduits to design and build. Another feature of the Tulsa tests that will be welcomed is the data on the effect of bends in a stretch of the conduit and the discussion of these and of some Venturi meter data.

## Reforming the Trade Commission

COMMISSIONER HUMPHREY of the Federal Trade Commission, speaking before the Chamber of Commerce of the United States last week, in pretty plain words explained the change of heart that has come over that commission with the new blood that has been recently added. Truth to say the Trade Commission has not distinguished itself since its formation. It has done a great lot of investigating, a greater lot of telling about this investigating and a very small lot of actual reforming of evil conditions of business in this country. It was a denunciatory body, whose fulminations too often were not credited in the courts of review. Mr. Humphrey makes it clear that the present majority of the commission is not in sympathy with such practice or program. He assumes, what most of us know to be a fact, that most businesses are honest and that their directors are honestly trying to follow the law. Law, however, is not self explanatory; even the highest court divides on its interpretation. The commission, therefore, in the future purposes to give business the benefit of the doubt, to study cases of possible violations of law or decent business practice, to give the accused the right of confidential reply and to resort to publicity only when error or violation is, in the opinion of the commission, proved. A consistent following of this policy will restore the Federal Trade Commission to some standing in the minds of the American people.

## Ash Pit Piles May Char

THE average structural engineer, if asked whether a thickness of 2 ft. of earth and 3 ft. of concrete would be sufficient heat insulation for an ash pit would probably reply, "Yes, if the temperatures are not too high," and this qualifying clause would be typical of the caution and conservatism of the engineer rather than because he had any idea that temperatures would likely be high enough to penetrate such a barrier. There is another element to be considered, however, and if his experience had included the foundation renewal under the Portland steam plant described elsewhere in this issue, his answer would have added another proviso, namely, "if high temperatures are not too long continued." In the steam plant referred to, ash-pit temperatures of about 700 deg. F. were continued year after year (the plant had been in service 10 years). Just what temperatures were reached on the underside of the floor of the thickness mentioned is not known but enough heat got through to char the tops of the supporting piles and destroy their usefulness. In this plant the concrete slab was poured directly on sand and gravel in which the piles had previously been driven and hence there was no opportunity for a circulation of air under the slab. If destruction by charring can occur it is conceivable that under similar conditions, plus draft, fire might result. Hence caution and conservatism suggest that where time is a factor any design calling for wood under ash pits should be very carefully scrutinized.

## The Oil Tank in a New Light

STATISTICS just published by a committee of the American Petroleum Institute on oil tank fires, covering a record of ten years, make the remarkable showing that oil tanks are safer than ordinary dwelling houses. The percentage of dwelling house fire losses in one year is 0.63 per cent, the committee states, while the percentage of oil tanks burned is only 0.10 per cent per year. In fact, steel-roofed tanks are much safer

even than the last figure indicates, having a loss ratio of only 0.03 per cent. The committee states, "Steel-roofed tanks as a class appear to be negligible risks, regardless of the kind of oil stored. It is doubtful if there are many insurable risks that can show such low fire frequency." This is a violent overturning of current ideas, according to which an oil tank is by no means a specially desirable neighbor with respect to fire risk. It challenges one's faith in statistics, to a certain extent. The skeptical mind can, in fact, find some grounds for argument in the conceded incompleteness of the record of oil-tank fires and in the fact that the committee report is an ex-parte statement, made by the oil industry for the advantage of the oil industry with a view to furnishing a defense against certain demands on the part of fire-protection interests in the matter of oil-tank spacing. The other side has not yet been heard from. However, the report will probably raise argument more because of its conclusions than because of its basic statistics, which latter can hardly be so far wrong as to invalidate the general comparison above made. Making even large allowance for error in the record, the comparison indicates that an almost marvelous degree of safety has been attained in the storage of highly inflammable material—which is greatly to the credit of the men engaged in the oil industry. At the same time it casts an unfavorable light on our national achievements in fire protection of the home. In short, we must make our dwelling-house fire record about six times better than it is at present before the average home will be as safe an abiding place as the roof of an oil tank.

### Checking Up on Performance

ENGINEERING technique has been built up through the application of theory to observation of performance. And the observation is quite as important as the theory. Indeed it came long before theory and it persists as the final check. That element known as practical knowledge, without which no engineer can amount to anything, is nothing but the mental record of observation. It is worth questioning whether we are exercising that observation as we should. The final test of the validity of a design or the stability of a structure is its performance, and that performance is too frequently not observed closely or analyzed critically. An engineer writing recently to this journal offered this criticism of technical literature in general, that it does not devote enough attention to the present condition of works constructed some years ago with a view to determining the efficiency of the methods and materials used in their construction. It is valid criticism, but it applies to the engineer himself just as well as it does to the things he writes. Of course, every engineer knows something about the condition of those works he has built. Sometimes when they are a part of the project with which he is continuously connected he knows a lot about them. But as often as not he has no maintenance duties, or is removed to another field long before the test of time can be studied. His practice in the design and construction of similar works is apt to be based on the quality of the earlier works at the time of their completion, before they have had service and before any of the destructive elements appear. It would be well for every engineer to consider this criticism as it applies to himself and see if possibly he is not carrying around as mental equipment a lot of ideas that are based on early performance. And, as a matter of interest to those like ourselves who are engaged in purveying to other engineers information that one engineer learns it may be worth while to suggest that any observations that he makes after such a mental review would be excellent material for literary effort.

## Simplifying Building Design

REDUCTION of design floor loadings is recommended by the Building Code Committee of the U. S. Department of Commerce in a report just issued under the title "Minimum Live-Loads Allowable for Use in Design of Buildings." The work of this committee was initiated, three or four years ago, with a view to eliminating the waste in building construction which was claimed to result from the variations between the building codes of different cities. A model or standard building code suitable for adoption by any city in the country was therefore aimed at. The new live-load provisions are part of such a model code. With respect to their reduction of floor loadings it should be noted that cheapening construction in this way was not, we believe, primarily contemplated but is an incidental result of the work.

Reduction of design load assumptions has a close relation to safety, of course. The report therefore presents interesting questions to structural engineers and building officials from the point of view of safety as well as from that of simplification.

In order that the new recommendations as to minimum live-loads may be appreciated quantitatively, it should be said that in general they represent a reduction of current building-code floor-load requirements by 20 to 30 per cent. Residential, hotel and hospital buildings are to be designed for 40 lb. per square foot (in a few cases 30 lb.) where current practice ranges up to 60 lb.; office buildings and schools, 50 lb. in place of the present 90 to 100 for schools and 60 to 75 for the upper floors of office buildings. Impact, which has recently been receiving some attention as a factor of possible importance in building design, is dismissed as negligible; the stated loads are held to be sufficient to cover impact also. The load recommendations, moreover, are declared to be in no way dependent on low working stresses, and the committee specifically "takes the stand that these are independent considerations and should be so treated. Live-load requirements should be adopted with reference only to the *probable actual* conditions of use. Stress limits should be based on the known ultimate strength of materials with due reference to workmanship and use conditions affecting uniformity and durability of the material."

We emphasize the words "probable actual" in this quotation, for they relate to the circumstances under which safety is jeopardized. Safety of buildings is, broadly stated, dependent on abnormal rather than normal service. There is not very much doubt or uncertainty as to the adequacy of a hotel or school-room floor under normal equipment and use; the critical test is that of abnormal loading. Load assumptions made in design, and those prescribed by building codes, therefore find their true test of adequacy in load contingencies, and the "probable actual" conditions of use must be compared with those rarer contingencies rather than with the ordinary every-day service. Correspondingly, reduction in live-loads is not important as affecting the service value of the structure for its normal use, but

it is vital in so far as it cuts into the safety margin of the structure with respect to the chance occurrence of abnormal service.

It is with respect to the possibilities of overloading, then, that the engineer and the building official will need to judge of the suitability of the proposed live-loads for their own use. The committee, it appears, has endeavored to fix design loads as close as possible to actual loadings found in normal service, with no particular margin for overload—chance or intentional—and no allowance for impact or other irregularities of behavior. It proposes to control overloading by proper supervision of occupancy and use: "The occupant of the building shall be responsible for keeping the actual loads below the certified limits. Adequate measures shall also be taken by the building official to insure that these loadings are not exceeded." These are admirable safety provisions in their intent, but it remains to be shown whether they are effective in accomplishing the purpose intended. They cannot in any event serve to protect against overloads resulting from mere chance—a category by no means negligible, and usually a controlling reason for making the estimate of future loading rather ample.

Looked at from the standpoint of simplification, the present recommendations follow quite the same lines as those conventional in building code practice. They attempt to classify buildings in a large number of groups, each representing a single type of occupancy or two or three types closely related, and then fix live-loads representative of that occupancy. Such rules produce buildings whose destination is fixed at the time of their first construction, to remain fixed throughout their existence. A building that is built for residential purposes must always be used for residential purposes; it cannot be used as an office building or for mercantile, manufacturing or storage purposes. The locality in which the building is erected may wholly change in character within a generation or less, so that the residential building no longer is wanted for that purpose, or the office building becomes more desirable for light manufacturing. The rules as drafted take no account of this, but on the contrary make it necessary to demolish or rebuild the structure if a changed use is to be provided for. The result can hardly be other than to make our "permanent" buildings shortlived.

What the structural engineer actually plans is something other than that foreseen in building code regulations of this kind, even though he may use a building code as his guide. In proportioning framework floors and walls he actually designs a building of a given carrying capacity rather than one for a given use—special cases excepted. And, after all, the load-capacity classes with which he is concerned are relatively few in number. Three to five load classes would probably suffice to cover most of the field of city building design, outside of exceptional structures for individual heavy service.

A load schedule of this kind would represent genuine simplification. In the long run it would mean economy, and by facilitating the co-ordination of carrying capacity and class of service, it would also contribute to public safety, not only now but in the future life of the buildings concerned. These are the ultimate objectives of all building codes. The simplification proposed in the present live-load recommendations will find its test in the results which it produces a decade or two hence, even more than in the results of today. It is sure to produce lighter—weaker—buildings, and this on the authority of men whose prominence gives high standing to the recommendation. If this lightening contributes to maintained life and serviceability it will be justified. In the other event it ought to fail.

## The Voice of Business

LAST WEEK the Chamber of Commerce of the United States, with fitting ceremony, formally dedicated its new building, the home for American business it has erected in the nation's capital. The dedication coincided with the thirteenth annual meeting of the chamber, and was made the occasion for surveying the chamber's accomplishments. The verdict "Well done" was pronounced not only by leaders of American business but, with especial emphasis, by the Chief Justice of the Supreme Court, Mr. Taft.

Thirteen years ago the chamber set forth on its mission of crystalizing and mobilizing the opinion of business men and then of making that opinion available to officers of government and to legislative bodies. It had first to stimulate the thinking of business men. It had to direct their study to questions affected with a commercial and industrial interest. It built up a research organization at Washington to get the facts. It adopted the referendum; it prepared carefully compiled studies of important questions; and it flung these out to chamber of commerce and trade and industrial associations in every nook and corner of the land, demanding that they discuss the subjects and send their views to national headquarters. The interest of business men was stimulated, opinions were formed and crystalized and then made vocal and available to government officials and to legislative bodies.

What has been the fruition? Mr. Taft was clear and positive in his answer. "You have builded," he said, "a center of influence that has made, and will continue to make, for the great good of this country. You have united, in a common and effective purpose, the great body of intelligent and active business men of the United States, and you have furnished for the people of this country an instrument for the effective organization of public opinion that is and will continue to be of the highest benefit."

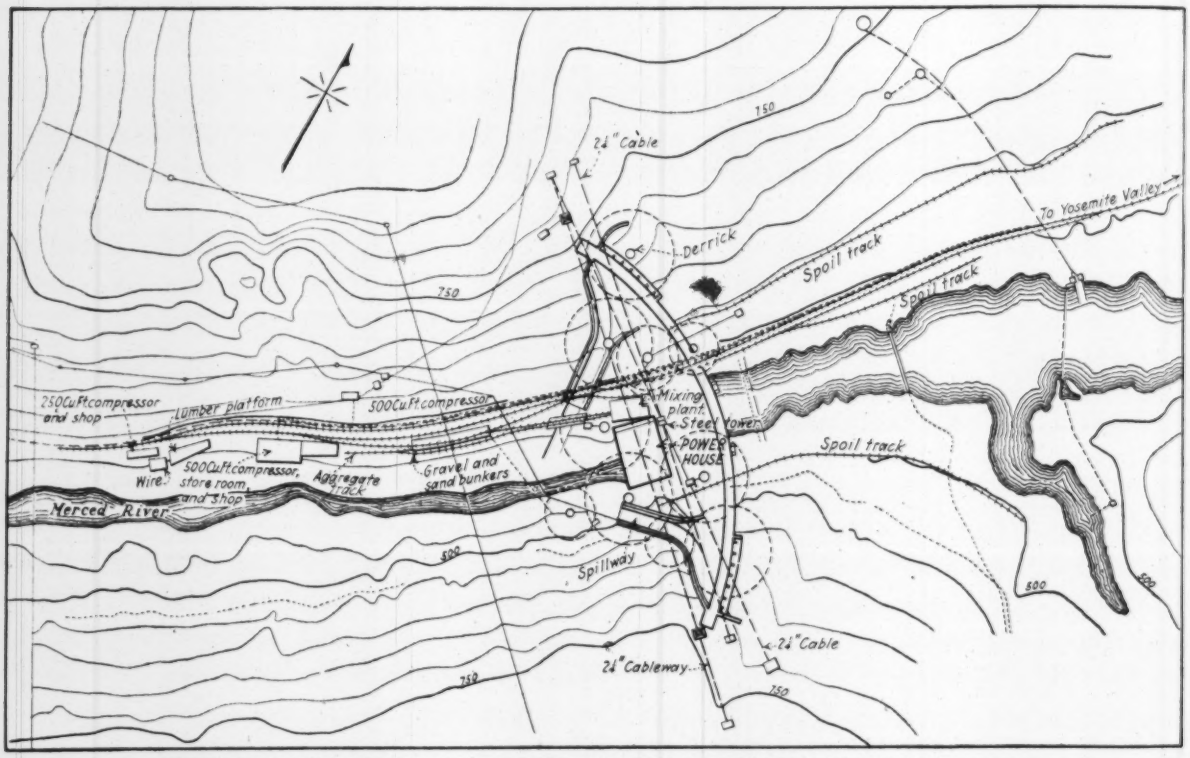
The spirit of its work is no less important than its quality and effectiveness. Happily it recognized at the outset that the public interest was paramount. In that spirit has it worked. Here again Mr. Taft pronounced the verdict. "You are not a faction," said he. "Taken together, you have no selfish or other aim, narrow or contracted, that blinds you to the general good. You are not cranks. You are not men of one idea. As much as any set of men you have in you as a whole the catholic spirit of good will to all elements of society."

With its prestige established, with a reputation for devotion to the public interest, with an enviable record for accomplishment, with strong backing as evidenced by its membership of 1,300 chambers of commerce and trade associations and of 12,000 individual and associate members, with an annual income of $1,000,000, the chamber, so long as the wisdom displayed in its past direction remains with it, has before it a future of wide and efficient service to business and to the public.

# Exchequer Dam Construction Plant Built in Narrow Canyon

**Cableways and 20-In. Chuting Systems Are Features—Three Gravel Sizes Used—1,600 Cu.Yd. of Concrete Daily in March—Designed Under Restriction of Only Two Days' Storage Permitted**

EXCHEQUER Dam on the Merced River in California, which is being built to develop storage for the Merced Irrigation District, called for a construction plant layout that would fit into a narrow canyon already occupied by the Yosemite Valley R.R. In addition to extreme space limitation the work has to be carried on without interfering with railroad operation while the dam is being built literally around the track. The 280,000-acre-ft. reservoir which the dam will create is to conserve flood waters for irrigating 181,000 acres in the valley below; incidentally a power house with a capacity of 33,500 hp. is being built into the dam.

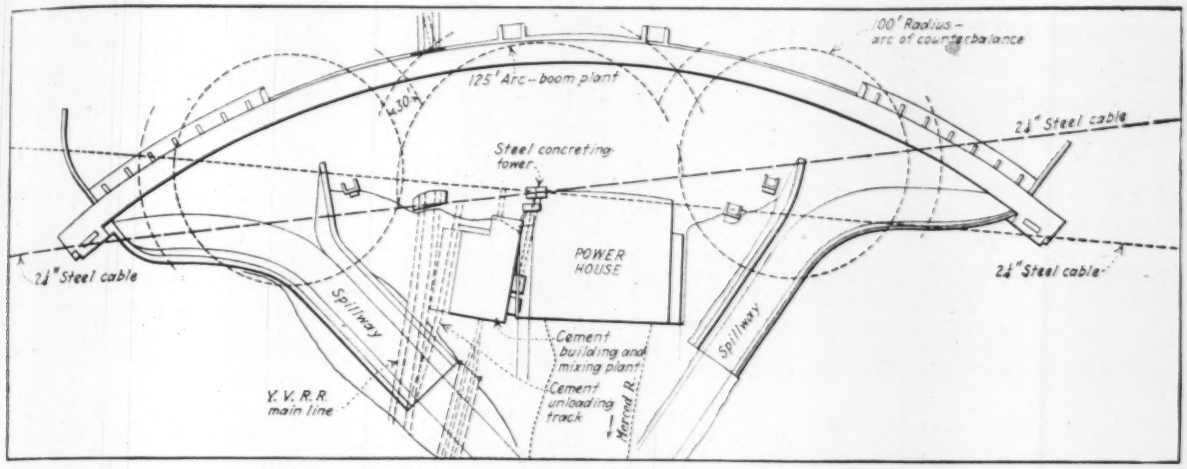



MERCED CANYON SHOWING RELATIVE LOCATION OF PLANT, RAILROAD AND DAM

The dam will have a total height of 330 ft. and will contain 400,000 cu.yd. of concrete, including power house and spillways. A feature of this structure is that practically all its height will be effective, that is, the height from extreme low water to flood level will be 304 ft. It is laid out as a simple arch on a radius of 675 ft. and a crest length of 955 ft. A 16-ft. roadway is to be built on top of the dam. The contract, which was for $2,370,000 exclusive of cement and steel, was signed last August and the work is to be finished early next year.

The only location which could be used for the construction plant was under such severe space limitations that it was not feasible to provide more than one day's storage for aggregate and a two-days' supply of cement. Hence the continuity of the work is dependent upon the operation of the Yosemite Valley R.R. between the dam site and the gravel pit which is in the Merced River bed 17 miles downstream. The present location of the railroad passes through the dam site at about one-third the height of the dam, necessitating the relocation of some 17 miles of the railroad at a higher level. This relocated line is now being built and is to be ready for operation before the reservoir is filled. On the present line the traffic is heavy, the average being 22 trains per day, eleven each way, which makes it impossible for construction operations to occupy the track for any considerable length of time. The dam is being built around the track, leaving a tunnel through the structure for the use of trains, until the relocated line shall be ready for service. The spillway channel on the north side of the dam passes under the Yosemite R.R. and between the mixing plant and bunkers for aggregate.

*Concreting*—Material at the gravel pit is washed and segregated into four classes—sand, fine gravel, coarse gravel and cobbles. The material is dug by a 2½-cu.yd. dragline, hauled in side-dump cars to the screening plant and elevated by a 36-in. belt conveyor. The installation provides for a daily output of 2,000 to 2,500 cu.yd. The four classes of material are shipped separately in 25-cu.yd. bottom-dump cars to the dam site. Normally, five trains of 16 to 18 cars each are required per day and this rate of delivery on the 16-mile haul is being made with two train crews. The material plant is at times a limiting factor in progress at the dam because of the fact that it must furnish sand and gravel to the contractors on the railroad-relocation work.

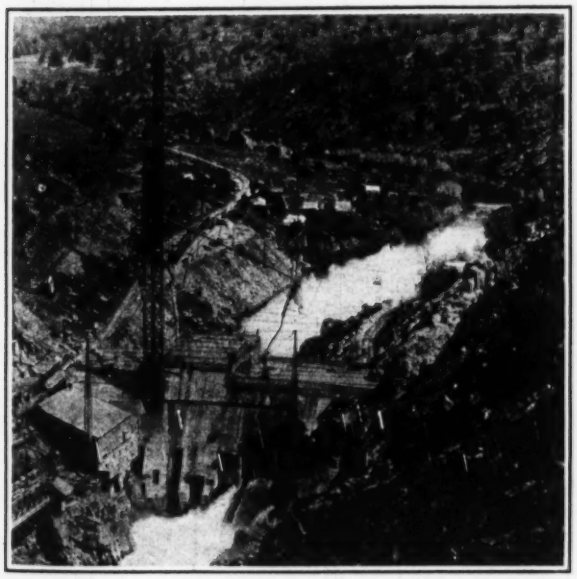



PLAN OF DAM SHOWING RANGE OF THE SEVERAL CHUTING SYSTEMS

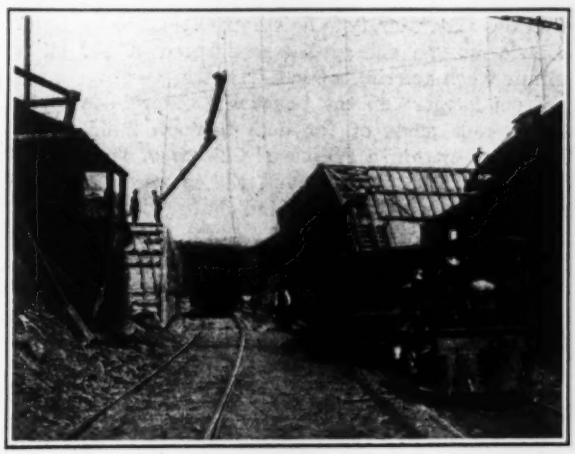
As the cars from the gravel pit are delivered at the dam site they dump into compartments beneath the bunker siding. The cars are spotted for this dumping by an 8-ton gasoline locomotive, which also handles the other switching at the dam. The combined capacity of the four compartments is about 1,800 cu.yd.

The different classes of material are measured into adjustable metal boxes beneath the bunkers, each box being adjusted to contain the right amount of material for one batch. These boxes are dumped into batch cars used to convey the aggregate to the mixers. Two trains of the batch cars are operated by 4-ton gasoline locomotives, using 2 or 3 cars per train, according to the number of mixers operating. A two-car train can load each car with its four classes of material required for a batch, deliver the two batches to the mixing hoppers and return to the bunkers in less than three minutes. This round trip requires seven stops and a total run of nearly ¼ mile. Spring switches are used, and except for stub ends, the entire distance to the bunkers is double track.

Three men are required to charge and dump the measuring boxes, and one man to dump the cars at the mixer hoppers. Cement comes to the mixer via chute from a hopper beneath the cement floor. The mixer hopper is dumped by the mixer operator who also regulates the amount of water used—the latter being done on a time basis, for a certain valve opening.



MERCED CANYON LOOKING UPSTREAM AT DAM
Cement house and mixing plant at base of tower which is to go 100 ft. higher than shown in this view. Spillway excavation at the right.



BEGINNING OF ARCH OVER RAILROAD TO MAKE TEMPORARY TUNNEL THROUGH DAM

A standard batch consists of 7 sacks of cement, 25 cu.ft. of sand (passing ¼-in. screen), 14 cu.ft. of gravel (¼- to 1½-in.), 27 cu.ft. of coarse gravel (1½- to 2½-in.) and 19 cu.ft. of cobbles (2½- to 10-in.). The resultant concrete yield is 59.8 cu.ft., the fineness modulus of the mixed aggregate being 6.94. The ratio of cement to the mixed aggregate was found by application of the Abrams theory working to a consistency of 1.20 (5-in. slump) and a strength of 1,800 lb. per sq.in. (28-day test). Daily compression tests are made to check the strength of the mix and any considerable change of fineness modulus is met by a change of the mix.

A special mix of richer proportions is specified for the first five feet back from the upstream and downstream faces of the dam below El. 500 (about 97 ft. above low water). No plums are used in the concrete, nor stones larger than the 2½- to 10-in. cobbles.

Three electric-driven 60-cu.ft. batch mixers are installed, but one of these is regarded chiefly as a standby

to be used in case of break or accident to the other two mixers. However, it is planned to use this third mixer in speeding up the work to the maximum production when the supply of materials is sufficiently large.

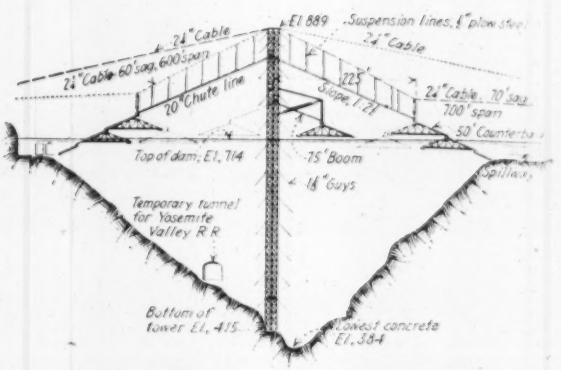
During March the average day's work was about 1,600 cu.yd. although a single day's run of 2,100 cu.yd. was made. It is hoped when all parts of the construction plant are working to best advantage that a placement of 50,000 cu.yd. per month can be maintained for a period of three months.

The mixers are operated on a schedule such that the complete cycle of operations on each batch requires 2 minutes. Of this time approximately 45 seconds is consumed in charging and discharging, so that the actual time (for the full batch) of turning over in the mixer is about 1¼ minutes.

The concrete is chuted from the mixers to a hopper at the foot of the double compartment steel tower. A swinging air-controlled chute discharges to whichever skip is being filled. This chute swings to a central position when not discharging and an electrical signal wire is connected through this central position of the swinging chute so that the "hoist" signal can not be given by the tower signal man when the chute is in the discharging position. Elevator type hoists are operated by 150-hp. electric motors, and give a rope speed of 400 ft. per minute when hoisting a 60-cu.ft. batch.

From hoppers on the tower the concrete is carried to different parts of the dam through 20-in. chutes. That part within a radius of 125 ft. of the tower is served by a boom plant and the more distant areas are reached by counterweighted chutes, suspended from 2¼-in. cables passing over the tower but not attached to it. These cables also carry the line chutes which carry the concrete to the center of the counterweighted chute.

The ultimate height of the tower will be 475 ft. —100 ft. more than the first section shown in the accompanying pictures. This double compartment tower will carry two of the 20-in. counterweighted chute systems together with a 125-ft.-radius boom plant and the necessary line chutes. These systems will reach practically all of the top of the dam. Each will be carried on a separate 2¼-in. cable and will have a 70-ft. sag with a span of 700 ft. (tower to anchor) and an estimated load (when concreting) of 40 tons. These




ELEVATION OF TOWER AND CHUTES

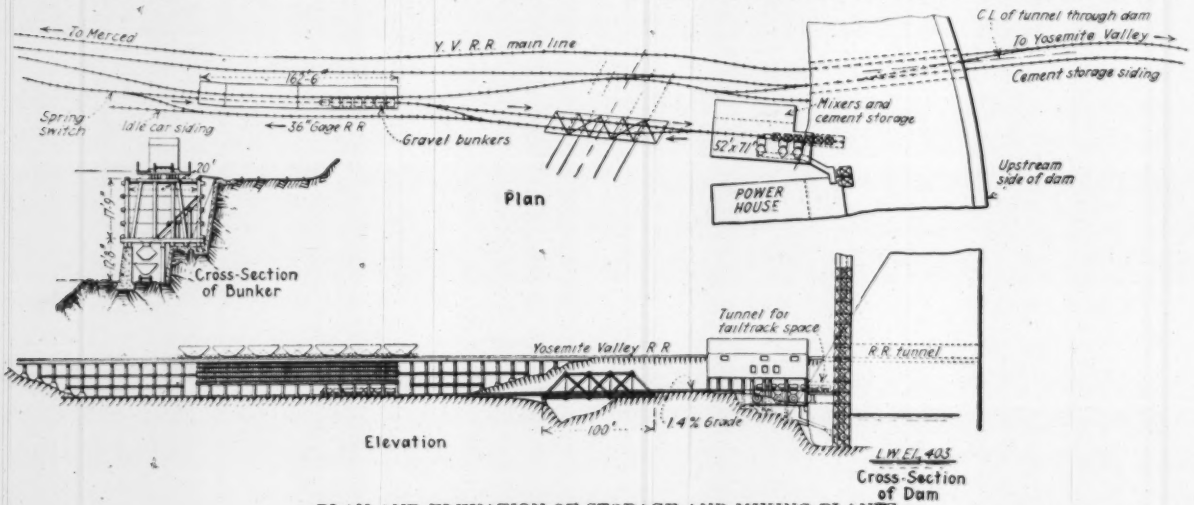
1,400-ft. cables will cross on top of the tower, forming in plan a letter *X* with a distance of about 120 ft. between anchorages on the same side of the stream.

The anchors for the 2¼-in. cables are massive reinforced-concrete deadmen bedded in rock, with a smaller central section in the form of a short cylinder 4 ft. in diameter. The cable is passed around this cylinder and the end is clipped to the incoming line. Enough room around the cylinder is provided for convenient installation and dismantling. Similar anchors are used for the 2¼-in. 10-ton cableway.

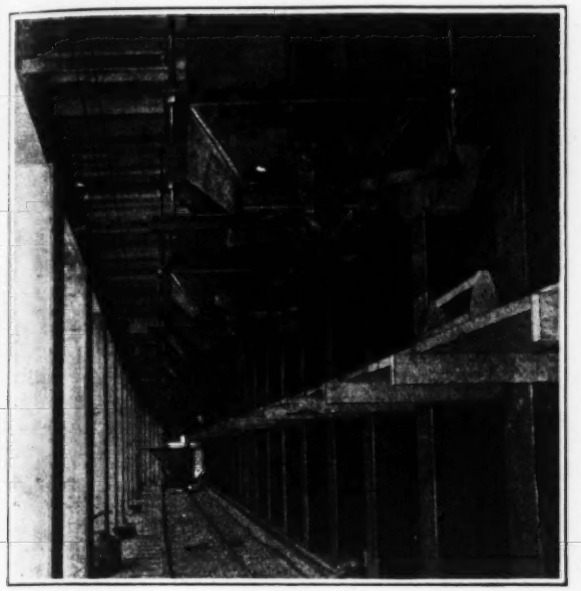
A 1¼-in. cableway is used for the erection of the tower and for other light hoisting within its reach. The towers are guyed by cables run out from each corner at height intervals of 40 ft. Plow steel cables 1¼ in. in diameter are used for this purpose and are anchored into rock by means of heavy U-bolts sulphured into holes 3 or 4 ft. deep.

The normal rate of progress on this job calls for six cars of cement in transit from the mill, six cars in the yard and 6 to 12 cars stored in the warehouse. This provides about the same safety factor against interruption to transportation as does the capacity of the bunkers in which the aggregate is stored.

The cement is unloaded from box cars onto a chute which delivers to the cement room above the mixer charging hopper. For each mixer in operation the crew handling cement consists of two men unloading from the box car, two men racking up sacks ready for dumping and cutting the wires, and two men dumping




PLAN AND ELEVATION OF STORAGE AND MIXING PLANTS



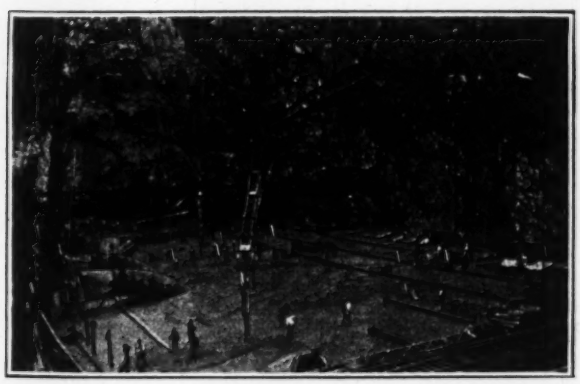
UNDER THE AGGREGATE BUNKERS
Concrete columns at left and concrete foundation at right. Note heavy construction of measuring hoppers and gates. Plank runway for men operating gates at the right.

the sacks (on signal) into the charging hopper. In addition to the foregoing, one man on the sack shaker and one man bundling sacks take care of these operations when two mixers are working. With this crew a total of 6,000 to 7,000 sacks of cement are handled in the ordinary day's run, consisting of two 8-hr. shifts.

The sack shaker is on the cement floor and in the usual screen cylinder, with internal dimensions about 6 x 6 ft., turned over with a charge of 200 sacks at 8 r.p.m. for ten minutes. After coming out of the shaker the sacks are tied in bundles and are returned to the car by a power hoist.

*Construction Procedure*—Dumping spoil below the dam, within feasible limits, was prohibited by the specifications. This made it important to excavate the spillway channels before the dam became too serious a barrier. The total volume of earth and rock to be moved was about 90,000 cu.yd. Two-thirds of this was completed prior to the end of March.

The power house, which is to be poured in the bed of the stream monolithic with the dam, will have a considerable area of vertical concrete poured against rock excavation. In these places deformed steel reinforcing bars have been grouted into holes in the vertical faces of the bedrock and bent so as to anchor the concrete to the rock. This feature, in connection with drainage of the conspicuous rock seams, is to prevent hydrostatic pressure due to ground-water seepage from endangering the bond with the rock. Similar precautions were also taken for the thinner parts of the turbine tailrace floor.



POURING CONCRETE IN EXCHEQUER DAM
Curb-walls on surface for bonding successive pours. Cut-off trench in background. Inclined inspection gallery form in middle foreground. Main line railroad and cement storage siding are located just in front of this picture.

A complete system of porous concrete drains is provided to collect any seepage water and carry it into the inspection and ventilating gallery drainage system. Drain pipes are also provided to collect any water which may seep through the concrete lying between the inspection galleries and the level at which contraction joints are begun.

Sheaves of extra large diameter are used for all cables to secure a maximum smoothness of operation and longer life for the rope. All anchorages are equipped with turnbuckles and sheaves for adjusting slack and all guys are provided with screw-pin shackles. All cables are kept greased, one man being detailed to the job of going over all of the rigging continually to keep bearings, sheaves and ropes well lubricated.

Concrete and reinforced concrete are used to a notable extent on this job for supporting units of the construction plant. Derricks, derrick hoist platforms, concrete mixers, bunkers, trestle and building footings are all built on concrete foundations. It is believed that the extra cost is made worth while by the avoidance of delays and other difficulties which result from settling foundations, even on a job where the entire duration of the work is figured at 20 months.

EXCAVATION FOR CUTOFF WALL AT NORTH SIDE
Curb-walls for bonding successive pours also shown

The machine-shop equipment is sufficient to make all ordinary repairs to equipment and has done a large part of the metal work on the job—making hopper and swinging chute at base of tower, chutes from mixer to tower, measuring devices under bunkers, and other equipment.

*Camp and Labor*—The camp is located a few hundred yards downstream from the dam where the canyon widens somewhat; here provision has been made for a total of about 400 men. The schedule in concreting

operations is to work two shifts, the hours being from 5:00 a.m. to 10:30 p.m. The change from first to second shift is made at 1:45 p.m. Common labor on this job is paid 50c. per hour. A feature of relations with the men in this camp is that in front of the paymaster's office on a large sheet behind a glass door there is posted daily the time of all hourly-rate men. This has been effective in avoiding disputes over "time."

Bent Brothers, Inc., of Los Angeles, are the contractors for the construction of Exchequer dam and power house; M. H. Slocum is in charge of the work as superintendent, and is responsible for plant layout. R. V. Meikle is chief engineer, Ross White resident engineer, and Daniel McFarland assistant engineer for the Merced Irrigation District. Designs for the dam were prepared under the direction of A. J. Wiley, Boise, Idaho, consulting engineer to the irrigation district.

# Water-Works Improvements at Kearney, Neb.

## Wells, Diesel Engines, Electric-Driven Centrifugal Pumps Supply Water to Circular Covered Concrete Reservoir

BY ELMER L. FERGUSON
Burns & McDonnell Engineering Co., Kansas City, Mo.

A CIRCULAR concrete reservoir of 1 m.g. capacity, and three new wells equipped with 1,000-g.p.m. centrifugal pumps driven by 60-hp. electric motors actuated by a 600-hp. Diesel oil-engine power plant are the chief elements of water-works improvements completed recently for Kearney, Neb. Other new work includes pipe lines connecting the wells and reservoir to the former system, pole line connections from the power house to the wells and additional distribution mains. Methods of sinking the well casings, staying the concrete forms and engine erection are of interest.

*Wells in Gravel*—The new wells have perforated ingot-iron casings, 26 in. in diameter, surrounded with

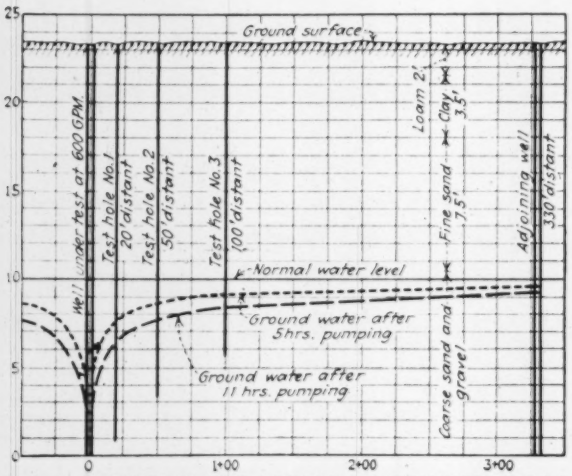



FIG. 1—GROUND-WATER LEVELS AT KEARNEY WELLS

7 in. of specially placed gravel. Water of excellent quality was found at a depth of 13 to 15 ft. in water-bearing gravel. The wells are bottomed in clay, found at about 43 ft., and have a bottom seal of concrete. Excavation was done by a 1-ft. orangepeel bucket working inside a 40-in. blank casing which was forced ahead of the digging by the weight of sand boxes placed on top and filled with the excavated material. Gravel was placed between the inner and outer casings while the outer casing was being pulled. The minimum spacing of the wells is 330 ft., at which distance the interference in drawdown of the ground-water is small. Test holes sunk between wells during one of the well tests showed the ground-water curve represented by Fig. 1. One well is located within the power house; the others are housed in brick buildings 10 ft. square. The pumps are in concrete pits approximately 12 ft. deep.

FIG. 2—CONCRETING CIRCULAR RESERVOIR WALL.

*Circular Reservoir*—A hill about 120 ft. above the main part of the city is the site of the covered reservoir, which is circular, 110 ft. in diameter and 14 ft. 5 in. high to overflow line. It is of reinforced concrete, covered and banked with earth. A flat 5-in. concrete roof slab is supported by columns spaced 10 ft. each way and connected by beams. Ventilation is provided by screened louvres in four manhole stacks 30 in. high, this height bringing the louvres well above the 12-in. earth fill over the roof. Gravel concrete was specified to be 1 cement to 6 aggregate, measured before mixing. The proper proportion of the gravel was determined by screening and separating it into two sizes, that retained on a ¼-in. screen and that passing the screen. The pit-run gravel, being too fine, was mixed with an equal part of the coarser screened gravel before using or testing for proportioning.

To facilitate working the concrete in the forms, the inside wall form was built up only a few boards ahead of the pouring, the carpenters working simultaneously with the concrete men (Fig. 2). Form stay wires through the concrete were avoided by an adaptation of the yoke principle used with sliding forms. The forms being securely fastened at top and bottom, intermediate support was supplied by means of a stout stay wire just above the level of the concrete and a heavy spreader about 2 ft. above the stay wire. As the pouring progressed, new wires were placed above, while the spreaders were raised and the lower wires removed before the concrete reached them. Since the rate of pouring was only about 5 in. per hour, concrete sufficiently far from the stay wires to gain much leverage on the yoke was well set before the wires and spreaders were moved. The entire wall was run in 45 hours continuous pouring; the floor was poured in one run of 24 hours. Joint filling was poured hot into the joint between the floor and wall, a large kerosene blow torch being used for drying and heating the concrete in advance. Expansion joints in the roof slab are also filled.

*Oil-Engine Power Plant*—Two 300-hp. Diesel engines are direct connected to two 250-kva. alternating-current generators (Fig. 3). The exciters are also direct connected. This power equipment, together with one well and pump, workshop and garage, is housed in a brick building 50x48 ft.; the engine room is about 24 ft. high, while the extension for the shop and garage is about 10 ft. high. The roof covering is of asphalt and gravel,

with inside downspouts. Ample light is provided by 950 sq.ft. of glass in steel sash for daylight, and by lamps with a total of 2,300 watts for night. With the ceiling painted steel gray and the walls whitewashed, the light is well diffused. Heat is supplied by a steam

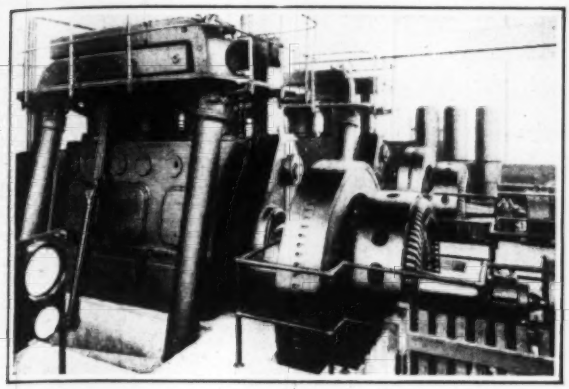


FIG. 3—DIESEL OIL-ENGINE POWER PLANT FOR ELECTRIC-DRIVEN PUMPS

boiler and radiation designed to keep the building at about 50 deg. F. in extreme weather. While running, the engines radiate some heat, but as the cooling water temperature is kept near 100 deg. the effect is small.

Three-cylinder, solid injection, full Diesel oil-burning engines with cylinders 17x24 in. are run at 225 r.p.m. Fuel is fed by gravity from a small tank filled by pumping from the large outdoor tank. Lubricating oil is also fed by gravity, a scavenger pump returning oil from the crankcase to the elevated tank. Engine piping is laid in trenches covered with steel plates. An improvised traveling crane, used by the erector in handling pistons and cylinder heads, consisted of falsework supporting two loose timbers across which was laid a 4-in. pipe having a hoist hung from it by a chain. After the engine part was raised, a man with pipe wrench rolled the pipe along to the final location. Compressed air for starting the engines is supplied by a compressor driven by a 6-hp. gasoline engine; it is stored in three tanks at about 210 lb. pressure, giving a supply sufficient for four or more starts. An air-whistle fire alarm is connected to the tanks.

In testing the engines, the load was applied by a water rheostat consisting of a wooden tank 4 ft. in diameter and 3 ft. deep; three ½-in. pipes used as electrodes were attached to a wood frame hung from a rope leading to the switchboard, so that the operator could watch the instruments while handling the rheostat. To prevent the water from reaching boiling temperature, a continuous stream was supplied through a rubber hose. At ¼ load, or 50 kw., the fuel-oil per brake-hp. per hour was 0.6475 lb.; ½ load, 0.488; ¾ load, 0.436; full load, 200 kw., 0.4205 lb. The power plant, which replaces an old steam plant, has considerable excess power over present pumping needs, and will be able to handle either lighting or further power load.

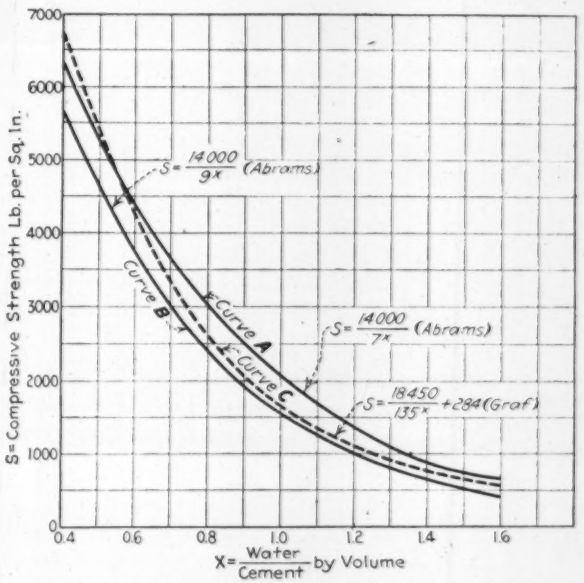
This new system gives the city a pumping capacity equal to twice its present maximum need, with a storage reservoir which serves as a regulator, keeping the pressure between 45 and 50 lb. The improvements cost $135,000, including engineering and incidentals. The wells were installed by the Well Works Co., Garden City, Kan., and the general construction was done by Knutzen & Son, Kearney, Neb. Engineering design and supervision were by the Burns & McDonnell Engineering Co., Kansas City, Mo.

## Abrams' Water-Cement Ratio Checked in Germany

By V. P. Mann
Instructor, Purdue University Civil Engineering Department, Lafayette, Ind.

EXPERIMENTS by Duff A. Abrams at Lewis Institute, Chicago, and by Otto Graf in Germany have led each to develop formulas expressing the water-cement ratio as a function of the compressive strength of concrete.

Their conclusions agree very closely as is shown by the accompanying graphs of their equations. Curves *A* and *B* represent Abrams' equations while curve *C* is




COMPARISON OF GERMAN AND AMERICAN STUDIES ON WATER-CEMENT RATIO

Graf's equation converted into the English system of notation from the equation

$$S = \left(\frac{1.300}{7^{w}} + 20\right) \text{ kg. per sq.cm.}$$

where $w$ is the water-cement ratio by weight.

Curve *B*, which is commonly used by Abrams to represent the lower range of values derived from his tests, is in close agreement with Graf's curve. Graf's equation was developed to represent the minimum concrete strengths found by testing 30-cm. cubes of concrete.

All of this seems to indicate that the water-cement ratio is the most fundamental factor of those which determine the strength of concrete and outweighs variations of materials and practices existing between Germany and the United States.

### New Use for Water Gathering Grounds

Nature lovers want to have the watershed of waterworks of Charleston, S. C., used as a resting place for migratory birds, stated James E. Gibson, manager and engineer of the water-works, at the recent convention of the American Water-Works Association. Mr. Gibson fears that the water supply might thereby be polluted.

# Stresses in Continuous Beams Determined Graphically

## Simple Procedure Based on Moment-Area Principle and Maxwell's Theorem Gives Reactions for Three or More Supports

BY I. DUBERSTEIN
Structural Engineer, New York City

CONTINUOUS girder problems may be dealt with in a simple way by applying a graphical method founded on the moment-area principle and Maxwell's reciprocal theorem. This method is briefly outlined in the present article.

As is well known, the elastic curve of a beam under any given loading may be obtained by drawing the equilibrium polygon for a load distributed in proportion to the ordinates of the bending-moment diagram corresponding to the actual system of loads. Thus, in Fig. 1, the curved line which forms the equilibrium polygon for a triangular load distribution is the deflection curve of the beam $R_1R_3$, resting on two supports, $R_1$ and $R_3$, under an upwardly applied load at the intermediate point $R_2$.

Such an elastic curve is also an influence line for the deflection at the point $R_2$ under a unit load traveling along the beam. For, according to Maxwell's reciprocal principle, the deflection which a unit load at $R_2$ produces at some other point of the beam is equal to the deflection which a load at this latter point produces at $R_2$.

The general principle may therefore be formulated: The influence line for the reaction at any support of a continuous beam is obtained by drawing the elastic curve for a load applied at that support, the support being considered removed.

*Two-Span Beam*—How this principle applies to a continuous beam of two spans is brought out by Fig. 1. The three diagrams in the upper part of the figure are bending-moment diagrams for the three simple beams obtained by removing successively each of the three supports and applying a unit load in its place. The upper diagram shows a unit load at the left end, the supports $R_2$ and $R_3$ remaining in action; the next diagram shows supports at $R_1$ and $R_3$, with a unit load in place of $R_2$, while the third shows a unit load at the right end, the beam supported at $R_1$ and $R_2$. It is evident that in each case the bending-moment diagram is a triangle with vertex at the middle support. The same bending-moment diagram, therefore, will serve for each of the three cases. By applying this bending-moment diagram as a load on the beam, and drawing an equilibrium polygon, the deflection curve of the beam is obtained; and this curve is an influence line for the reaction at the omitted support. It may be concluded, therefore, that a single curve represents the influence line for all three reactions, using in each case an appropriate base line.

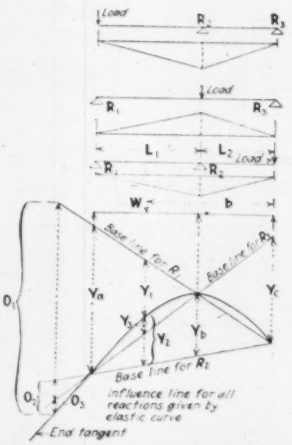



FIG. 1—DETERMINING REACTIONS FOR TWO-SPAN CONTINUOUS BEAM

In the lower part of Fig. 1 the elastic curve has been drawn. The three base lines and the method of measuring the reactions in the three cases are indicated.

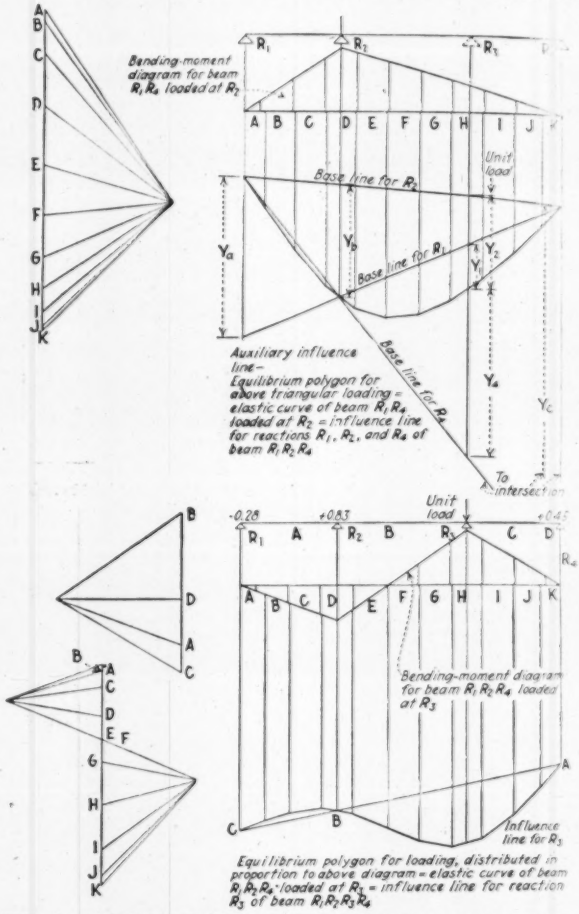

Bending-moment diagram for beam R1R4 loaded at R2
Unit load
Base line for R2
Base line for R1
Base line for R4
Auxiliary influence line—Equilibrium polygon for above triangular loading = elastic curve of beam R1R4 loaded at R2 = influence line for reactions R1, R2, and R4 of beam R1R2R4
To intersection
-0.28
+0.83
+0.45
Bending-moment diagram for beam R1R2R4 loaded at R3
Influence line for R3
Equilibrium polygon for loading, distributed in proportion to above diagram = elastic curve of beam R1R2R4 loaded at R3 = influence line for reaction R3 of beam R1R2R3R4

FIG. 2—AUXILIARY INFLUENCE LINE USED TO DETERMINE REACTIONS OF CONTINUOUS BEAM ON FOUR SUPPORTS

Measuring the distances shown, the reactions for any given load $W$ will be

$$R_1 = +\frac{y_1}{y_a}W;\ R_2 = +\frac{y_2}{y_b}W;\ R_3 = -\frac{y_3}{y_c}W$$

It may be seen from the figure that $y_1$ and $y_a$ lie on the same side of the base line and accordingly $R_1$ is positive; similarly, $y_2$ and $y_b$ lie on the same side of the base line and $R_2$ is positive; but $y_3$ and $y_c$ lie on opposite sides of their base line, making $R_3$ negative.

Different scales apply to the curve when used as influence line for the different supports. However, in the expressions just given, the effect of scale appears in both numerator and denominator, and therefore is without effect. Under other circumstances the scale of the curve may require to be taken into account.

*Two-Span Beam With Overhang*—The procedure just given still applies when the beam has an overhang beyond one of the end supports. The end tangent of the elastic curve is drawn; when the curve is obtained graphically this is the continuation of the last string of the equilibrium polygon. The deflection ordinates are measured between this extension of the elastic curve and the extension of the appropriate base line. In Fig. 1 the deflection ordinates for one point of an

overhang beyond the left support are marked ($o_1$, $o_2$, $o_3$). The three reactions under a load $W$ applied at that point would be,

$$R_1 = +\frac{o_1}{y_a} W;\ R_2 = -\frac{o_2}{y_b} W;\ R_3 = +\frac{o_3}{y_c} W$$

Note the changes in sign from the case previously considered. The algebraic sum of the reactions must equal $W$, which furnishes a check on the calculation.

An analytical proof that the influence line for one reaction is also an influence line for the other reactions

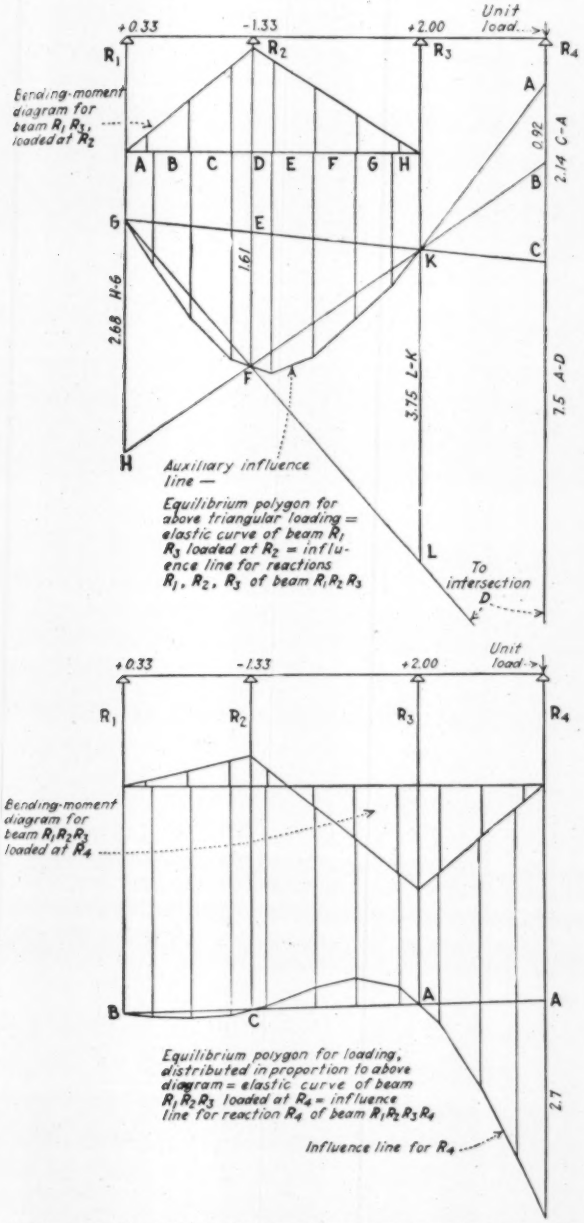

+0.33
-1.33
+2.00
Unit load
R1
R2
R3
R4
Bending-moment diagram for beam R1 R2, loaded at R2
A B C D E F G H
2.14 C-A
0.92
2.68 H-G
1.61
3.75 L-K
7.5 A-D
Auxiliary influence line —
Equilibrium polygon for above triangular loading = elastic curve of beam R1 R2 R3 loaded at R2 = influence line for reactions R1, R2, R3 of beam R1 R2 R3
To intersection D
Bending-moment diagram for beam R1 R2 R3 loaded at R4
Equilibrium polygon for loading, distributed in proportion to above diagram = elastic curve of beam R1 R2 R3 loaded at R4 = influence line for reaction R4 of beam R1 R2 R3 R4
Influence line for R4
2.7

FIG. 3—APPLICATION OF STEP-BY-STEP METHOD TO END REACTION OF FOUR-SUPPORT BEAM

is easily obtained. Thus, let the curve in the lower part of Fig. 1 be known to be the influence line for $R_2$, so that $R_2 = Wy_2/y_b$. It may be proved that the same curve is also an influence line for $R_1$, and that $R_1 = Wy_1/y_a$.

Computing the value of $R_1$ from the known value of $R_2$, by taking moments about $R_2$, we have,

$$R_1 = \frac{Wb - R_2 L_2}{L_1 + L_2} = \frac{W\left(b - \frac{y_2}{y_b} L_2\right)}{L_1 + L_2}$$

$$= W\left(\frac{b}{L_1 + L_2} - \frac{y_2}{y_b}\frac{L_2}{L_1 + L_2}\right)$$

From similarity of triangles we have

$$\frac{b}{L_1 + L_2} = \frac{y_1 + y_2}{y_a}, \text{ and } \frac{L_2}{L_1 + L_2} = \frac{y_b}{y_a}$$

Substituting these values in the expressions for $R_1$,

$$R_1 = W\left(\frac{y_1 + y_2}{y_a} - \frac{y_2}{y_a}\right) = \frac{y_1}{y_a} W$$

which was to be proved. Similarly, the curve may be shown to be the influence line for $R_3$, with base line passing through $R_1$ and $R_2$ points of the curve (Fig. 1).

*Beam of More Than Two Spans*—The method outlined in the preceding can be made the basis for a procedure for finding the reaction influence line of a continuous beam of any number of spans.

A symmetrical three-span beam, symmetrically loaded, may be dealt with directly by the influence line for a two-span beam, by taking advantage of the fact that $R_1 = R_4$ and $R_2 = R_3$. Suppose it is required to find $R_2$; considering $R_2$ as a load acting upward, in the curve shown in Fig. 1, denote its deflection ordinate by $y_r$. Draw an elastic curve as shown in Fig. 1, for the girder of spans $R_1$ $R_2$ $R_4$, and apply the two symmetrical loads $\frac{1}{2}W$ (of any other symmetrical set of loads) and the unknown upward load $R_2$. The $R_2$ reaction ordinates under the two loads $\frac{1}{2}W$ will be $y_2$ (as shown in Fig. 1) and $y'_2$ (under the $\frac{1}{2}W$ load on the right-hand portion of the beam); the ordinate under the upward force $R_2$ (measured from the base line for $R_2$) may be called $y_r$, which represents the reaction at $R_2$ set up by unit load at $R_2$, and the $R_2$ ordinate under $R_2$ may be called $y$. Then from the nature of the curve as an influence line,

$$R_2 = \frac{y_2 + y_2'}{y} W - \frac{y_r}{y} R_2$$

But placing $R_2 = R_3$ and solving for $R_2$,

$$R_2 + \frac{y_r}{y} R_2 = \frac{y_2 + y_2'}{y} W$$

or,

$$R_2 = W\frac{y_2 + y_2'}{y_r + y}$$

In other words, the sum of the $R_2$ ordinates under the loads is to be divided by the sum of the $R_2$ ordinates under $R_2$ and $R_3$ of the influence line $R_1$ $R_2$ $R_4$.

*General Method*—When the load is not symmetrical, this method fails. It is then necessary to apply the general principle that the influence line for any support is given by the elastic curve drawn for a unit load applied at that support after removing the support.

Consider the three-span beam of Fig. 2, and let the principle be applied to the determination of reaction $R_2$. First, consider support $R_2$ removed and draw the reaction influence line for the beam $R_1$ $R_2$ $R_4$. This is indicated in the drawing, where below the beam is shown the bending-moment diagram, which is then taken as a loading, and with the help of the force polygon at the left is used for drawing the equilibrium polygon below, marked "auxiliary influence line." We now apply a unit load at $R_2$ and determine the reactions,

$$R_1 = -\frac{y_1}{y_a} = -0.28;\ R_2 = +\frac{y_2}{y_b} = +0.83;$$

$$R_4 = +\frac{y_4}{y_c} = +0.45$$

With these reactions and the unit load at $R_2$, the bending-moment diagram for these loads is drawn, as shown, with the help of the force polygon drawn alongside in Fig. 2. This bending-moment diagram, which consists of positive and negative parts, is then used to draw the equilibrium polygon, shown in the lower part of the figure. This represents the elastic curve for beam $R_1R_2R_3$ under a load at $R_2$, and by the principle stated at the outset it also represents the influence line for reaction $R_2$ in the four-support beam $R_1R_2R_3R_4$. The construction is checked by noting that the closing line of the equilibrium polygon passes through $R_1$, $R_2$ and $R_3$.

The other three reactions may now be obtained by considering $R_2$ as a load acting upward, with the aid of the auxiliary influence line. However, an independent influence line for each of the other reactions may be obtained by the principle already outlined. Its application to reaction $R_4$ is shown in Fig. 3.

Considering support $R_4$ removed, apply unit load in its place. This represents beam $R_1R_2R_3$ with an overhang, whose reactions are obtained as already shown in connection with Fig. 1. The procedure is given in detail in the upper half of Fig. 3. The procedure from this point onward becomes identical with that for Fig. 2: The three reactions under unit load at $R_4$ are calculated from the auxiliary influence line. Then these reactions and the unit load at $R_4$ are applied as loads, the bending-moment diagram is drawn (for beam $R_1R_2R_3$, loaded at the end of the overhang $R_4$), and with this bending-moment diagram considered as a load diagram the equilibrium polygon is drawn as shown in the lower part of the figure. This is the influence line for $R_4$.

*Extension of the Principle*—It will be apparent from the preceding that the method can be applied to a girder of any number of spans. For a girder having $n$ supports, an independent influence line can be obtained for any one reaction after drawing $n$-3 auxiliary influence lines. At each stage the principle clearly brought out in Fig. 1 is applied, namely, that for any given number of spans a reaction influence line may be obtained by drawing the deflection curve for a beam having one span less, corresponding to the original beam with one support omitted.

### Former County Engineer Causes Trouble

At the election last fall in Adams County, Wash., there was no formal nominee for the office of county engineer. When the votes were polled it was found that J. M. Moorman, a farmer with no engineering experience, had received 34 votes, the name of the office and his name having been written in on the ballot in each case. The county auditor refused to issue a certificate of election, but Mr. Moorman nevertheless filed an oath of office with the county auditor and took possession of the office as county engineer. He occupied that office for two months—January and February—although he did not handle any of the work, hired no men, and attempted in no way to execute the duties of the office. At the end of each month, however, he presented a payroll to the Board of County Commissioners which in each case was rejected. It is the contention on the part of the county that there was no election and therefore Mr. Moorman was not allowed to qualify. The matter remains in statu quo, the assumption is that action is up to Mr. Moorman.

# Foundations Under Steam Plant Renewed Without Shutdown

## Concrete Substructure Replaces 2,500 Wood Piles, Four at a Time, Without Settlement—Piles Under Ash Pits Badly Charred

By C. P. DUNN
Designing Engineer, Portland Electric Power Co., Portland, Ore.

THE PORTLAND Electric Power Co.'s steam station L, which is located near the center of the city of Portland, Ore., on the bank of the Willamette River, was built in 1910 to house boilers, steam turbines and generators. The building is 130 by 160 ft. in plan and the weight of the structure itself plus that of the equipment contained and the 300-ton chimney is distributed over the foundation by means of a concrete slab, 3 ft. thick, which in turn rests on Douglas fir piles, spaced on 3-ft. centers each way over the entire area.

The tops of these piles deteriorated to such an extent that late in 1923 it was decided that some new support

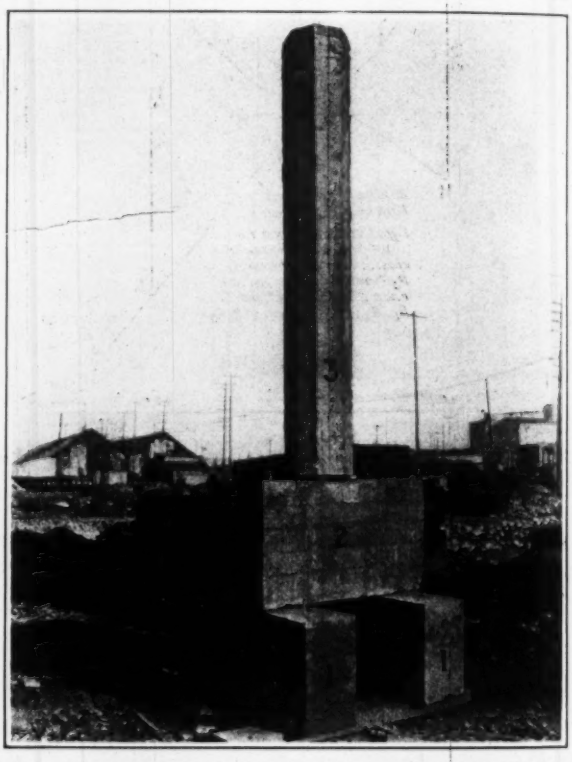


FIG. 1—CONCRETE ASSEMBLY REPLACED FOUR PILES
Steel wedges under column used to wedge it up into place so it would carry load immediately after installation.

for the slab was necessary if serious settlement was to be avoided. A scheme was then devised for cutting the piles off 14 ft. below the slab and substituting precast concrete beams and columns as slab supports, without interfering with the operation of the plant. This plan was carried out successfully as described below.

When this plant was built the ground was first graded off to El. 14.0 and piles were driven and cut off at El. 14.5, thus leaving 6 in. of each pile head embedded in the slab or mat which was poured on the ground at El. 14.0, the top of the mat being El. 17.0. Extreme low water of the river is El. 0.0 and extreme high water

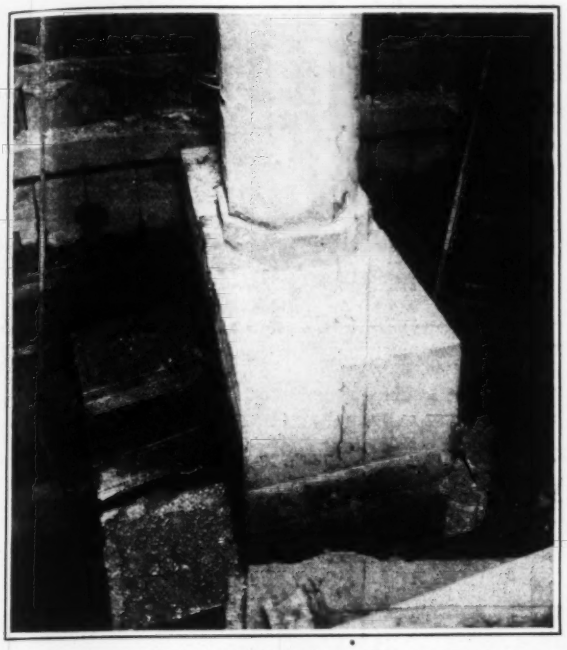


FIG. 2—CONCRETE COLUMN, BEAM AND PILE CAPS IN PLACE
Collar of grout around base of column to encase steel wedges.

is El. 33.0, the normal stage of the river ranging from El. 5.0 to 8.0.

Several buildings in the city of Portland have their foundation piles cut off at El. 14.5 or higher, the moisture in the ground preventing decay. The piles under Station L were moist at all times up to about El. 14.0 but at this level, due to the combination of moisture and heat and to the fact that the ground settled away from the mat about 2 in., decay occurred.

After a study of several possible methods, it was decided to cut the piles off at El. 0.0 and build up the 14 ft.

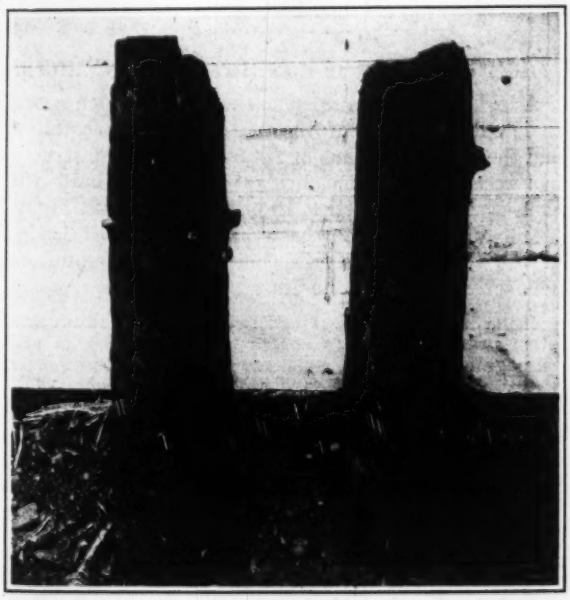


FIG. 3—CHARRED PILE TOPS FROM UNDER ASH PIT
Long continued temperatures of 700 deg. F. in ash pit penetrated 2 ft. of earth and 3 ft. of concrete, destroying the tops of supporting piles.

between this level and the bottom of the mat with a precast concrete structure. The use of precast members was the only way the work could have been accomplished in one low-water season (July to November) because in order to make rapid progress with the work it was necessary to be able to load the columns immediately after they were placed, so that adjacent piles could be removed. This precluded the possibility of brick piers or any scheme which would involve pouring concrete in place.

The possibility of cutting the piles off at about El. 6.0 was discussed. This plan would have involved protecting the individual piles between El. 6.0 and 0.0 with a 3-in. concrete shell which would have been placed by jetting down a sheet-metal casing 6 in. greater in diameter than the pile. This idea was abandoned because it appeared to be more expensive than the plan finally adopted and also because there was uncertainty as to the difficulties that might be encountered in jetting the casing down through coarse gravel.

*New Caps and Columns*—The scheme used was to build up a structure of precast beams and columns in such a way that one column replaces four piles, the total number of piles under the building (about 2,500) being replaced by about 625 structures of the shape and assembly shown in Fig. 1 and Fig. 2. The beams and columns are heavily reinforced with $\frac{3}{8}$-, $\frac{1}{2}$- or $\frac{5}{8}$-in. rods.

The maximum load on the old wooden piles was figured at about 14 tons per pile, making a load of 56 tons on one of the 17-in. octagonal spirally-reinforced columns. While the total load in some parts of the building was considerably less than 56 tons per column, no economy could have been effected by making more than one type of precast structure, and on account of the possibility of additional machinery being installed in the future it was deemed inadvisable to omit any of the columns; hence the entire supporting structure was made uniform throughout.

After the piles were cut off at El. 0.0 they were capped in pairs with precast beams (marked 1 in Fig. 1) which are $1\frac{1}{4}$ x 2 x $4\frac{1}{2}$ ft. in size. The beam on top (marked 2 in Fig. 1), which is 2 x $2\frac{1}{2}$ x $4\frac{1}{2}$ ft. in size, served as the direct support for the column (marked 3 in Fig. 1), which is of hexagonal section, 17 in. in diameter.

The joints between the beams and between the lower beams and supporting piles were made with 1:1 stiff mortar. The columns were cast about $1\frac{1}{2}$ in. short of the space into which they were to fit and about $\frac{1}{2}$ in. of 1:1 mortar was put on the top of each column as it was hoisted into place. At the bottom of the column, two pairs of 1 x 3 x 16-in. steel wedges were used to wedge the column up against the mat, the load being taken immediately by the concrete assembly when it was put in place. After the wedging was completed the space around wedges and underneath the column was filled with grout, a form slightly larger than the column and about 4 in. high being used.

*Method of Procedure*—It was necessary for this work to proceed very carefully because a slight settlement of any part of the foundation would have made it impossible to keep the steam turbines in operation. Precise levels were run daily in order that settlement might be observed immediately and stopped. Greatly to the credit of the construction men it can be said that no settlement of any consequence occurred during the entire work.

At the beginning of the work a transverse tunnel was

excavated about midway of the building with an elevator in a shaft at the end of the tunnel toward the river. For convenience in handling the excavated material, the 2-ft.-gage track was extended in all directions as the work progressed, turntables being installed at several points where right-angle turns were necessary. Muck and the concrete members were handled on small cars propelled by hand. One row of piles at a time was removed and the track installed. As the excavation proceeded, the decayed piles were temporarily cut off at about El. 9.0 and the load taken on square timbers used as temporary shores. This practice was followed throughout the work in order to make it possible to keep the excavation well ahead of the placing of the concrete without incurring the danger of settlement. The concrete structures were placed consecutively in rows across the building, working both ways from the first tunnel. Only four piles were removed at a time, the load being immediately taken by the new structure before the adjacent four piles were cut off. The concrete members were set in place by a chain block on an I-beam trolley which was shifted round as required and was supported from either finished columns or undisturbed piles, by means of steel bands bolted in place as collars.

As the work progressed the excavated material was backfilled around the completed work. It is believed that this backfill around the columns, which will be compacted by water, will provide all necessary resistance to swaying of the structure, but as an additional precaution some 500 lin.ft. of web walls have been placed between the columns for swaybracing. These walls are 5 ft. high and 8 in. thick, placed between El. 0.0 and 5.0, reinforced with ½-in. round bars spaced on 12-in. centers both ways. Before the concrete assemblies were put in place, each pile was tested to about 20 tons with a hydraulic jack.

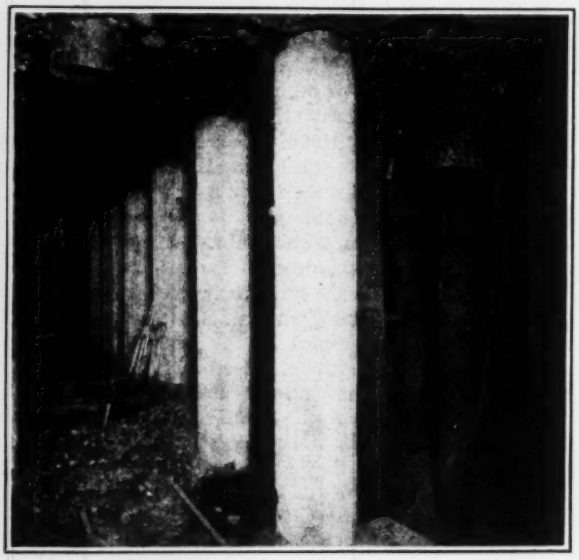


FIG. 4—THE OLD AND THE NEW SUPPORT
Finished work at the left. Excavation between wooden piles under way at right.

*Charred Piles*—Under the boiler room the piles were in general decayed about the same as they were under th engine room, being soft for a few inches at the top and sound below. However, under the ash pits the tops of the piles were charred away, leaving the concrete mat under the ash pits almost unsupported. This charring occurred despite the fact that in addition to the 3-ft. thickness of the concrete mat there was about 2 ft. of earth fill in the bottom of the ash pit. The normal ash pit temperature is about 700 deg. F.

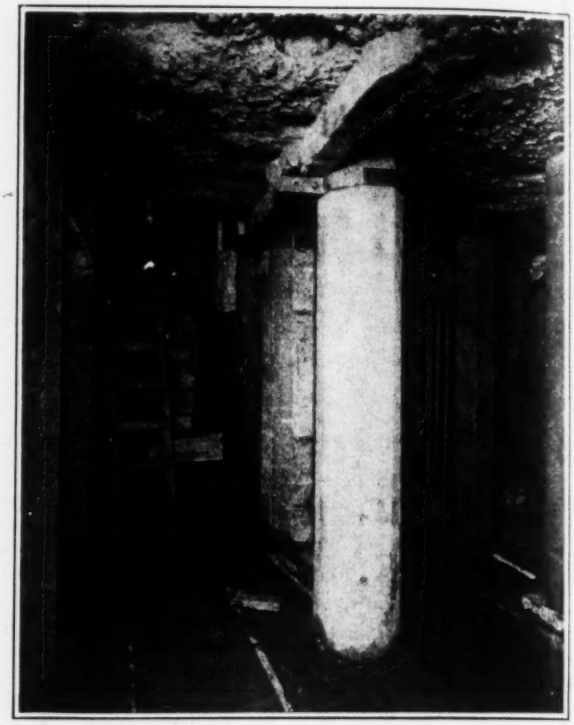


FIG. 5—SCHEME FOR ERECTING COLUMNS UNDER MAT
I-beam trolley supported on brackets bolted around piles already in place.

*Construction Staff*—The construction work was done by the Raymond Concrete Pile Co., through J. A. Currey, Portland representative, the men in direct charge of the job being G. W. Mills, William Bailey and B. M. Begg.

## Wider and Stronger Road Bridges for California

A legislative commission in California, which recently reviewed the work of the state highway commission and the major problems of future highway construction, has recommended that bridges should be built wider than is common practice, in order to give full highway efficiency. It also forecasts increased truck loads in future, though giving no specific weight estimates. The following is taken from its report:

Instead of restricting the highway width, bridges and other drainage openings should be wide enough to permit passage of traffic with equal ease as on adjacent road sections. The economy effected by restricting bridge width is at the sacrifice of highway efficiency and results in a real danger to traffic.

New structures should be designed to a greater width than the adjacent pavement, even to the full width of the grade in the case of medium spans. They must be designed to carry the maximum loading of as many trucks as may at one time come upon their surface.

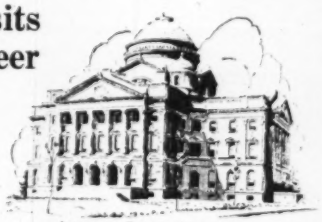
The present tendencies toward the design of six- and eight-wheel trucks which will increase the carrying capacity and total weight without increasing the weight per inch width of tire on the road surface, are being closely followed by highway engineers. The development and use of such trucks will require still heavier designs than now used for highway bridges.

# Engineering in the Small City

**A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000**

## The Editor Visits the City Engineer

*Snapshots of Our Representative Small Cities*



LUZERNE COUNTY COURT HOUSE

## Wilkes-Barre, Pa.

COUNTY SEAT OF LUZERNE COUNTY, PA., 145 miles by rail north by west of Philadelphia on the Susquehanna River. Center of most productive anthracite coal region. Large manufacturer of laces, wire rope, iron products, adding machines, silk, flour, clothing and munitions. First settled in 1769. Destroyed in 1784 during Pennamite-Yankee war. Rebuilt and incorporated as borough in 1806, chartered as city in 1871. Takes name from John Wilkes and Col. Isaac Barré, advocates of the colonists in British Parliament preceding Revolution. Pop. (est. 1924) 75,000.

WHEN it is known that an engineer has held a position in a particular city engineering department for close to half a century, one expects little interference with technical matters by persons in municipal administration holding superior offices. This is exactly the atmosphere one finds when sitting down with B. K. Finch, city engineer of Wilkes-Barre, Pa., and for the past 40 years an employee of the city engineering department of that municipality. Incidentally, in point of service, there is only one city engineer in Pennsylvania who is ahead of Mr. Finch, and that is Mr. Cowden, who has been in the city engineering department of Harrisburg for more than 50 years.

Wilkes-Barre has the commission form of government and the city engineer's office is organized under the Department of Streets and Public Improvements. With water supply furnished by a private utility, the principal engineering responsibilities of the city engineer's office are streets, sidewalks, and sewers. Initial engineering installations, particularly the sewerage system, having been ample and very well constructed, Mr. Finch has spent most of his time recently in street work and in the perfection of office administration.

Paving in Wilkes-Barre has been largely of sheet asphalt. Mr. Finch believes that it is most applicable to city work because of the ease with which the pavement cuts can be made and repaired. He believes pavement cuts are inevitable even though principal subsurface installations were required to be laid in advance of paving work. Such cutting, to his mind, is the sign of a healthily growing municipality. Out of 100 miles of streets and alleys (the latter are invariably dignified by the word "lanes"), 57 miles are paved and of the paved streets 34 miles are sheet asphalt; the rest is brick.

Mr. Finch has laid particular stress latterly upon the provision of adequate maps both for assessment and for general office use, for all taxes from which the city derives its revenues are based upon these maps. Two assessment engineers are kept busy all the time in keeping up-to-date the assessment maps. There are approximately 17,000 pieces of property within the city limits and there are at least 2,000 transferences of property each year, and all of this information is kept in a card index with suitable and explicit map reference. When a transference of property is executed the new owner's name is put upon the assessment map in the city engineer's office by a definite numbering system, so that immediately upon the notation on this assessment map of the change in ownership the assessment engineer goes to the city assessor's office and makes the same notation on the duplicate file. This means complete accord between the city assessor's office and that of the city engineer in the matter of property ownership and physical descriptions of property as filed in each office.

As Wilkes-Barre lies on one side of the Susquehanna River and is the hub of an area with a population of 300,000 people within a radius of 5 miles, and as the railroad terminal space is rather restricted because of this fact and the topography of the surrounding country, the city has a definite grade-crossing elimination problem. There are 40 crossings, the principal railroads being the Lehigh Valley, Central Railroad of New Jersey, and the Pennsylvania. A report on the possibility of grade-crossing elimination was presented by the city engineer in connection with a study made by the railroad a number of years ago. This report proposed an expenditure of some $4,000,000, three-quarters of which was to be borne by the railroad companies and the other one-quarter by the city. Nothing was done with this and the city is now erecting a bridge over all the tracks as a main north and south street artery. This bridge alone will cost close to $1,000,000, the railroads contributing $155,000 and the county of Luzerne $125,000. Thus the city is practically paying for one crossing elimination what the entire program would have cost ten years ago.

The sewer system is principally made up of 15 trunk lines discharging directly into the Susquehanna River. There are 113 miles of sewers in the city and not more than 50 houses within its limits lack sewer connections; work is under way at the present time to connect even these with the general system. At the present time the discharge of sulphuric acid from mine wastes into the Susquehanna has charged the water so that the sewage is pretty well clarified. Hence it is considered quite safe to continue discharging sewage as is being done. However, the same pressure is brought to bear on Wilkes-Barre as is brought to bear against all towns along the Susquehanna that use the river as a means of sewage disposal. Alexander Potter is the city's consultant on sanitary matters and he has made a study of the situation, recommending an interceptor and a sewage disposal plant. Preparatory to any future installations, the city will make extensive flow studies in the sewers during the coming summer. The business section of the city is flat and there is about 30 ft. difference in normal water level and street grade, so

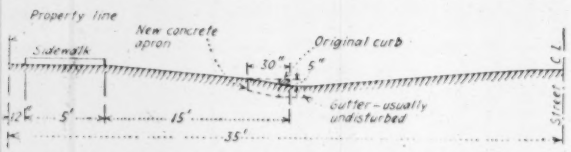
little trouble is experienced even during high water from water backing up in sewers.

Wilkes-Barre is underlain by a rich coal deposit. As none of this in the center of the city has been mined no difficulties from failure of structures through mine subsidence have been experienced. Eventually these rich veins will be mined, but that day is no doubt far away.

The city has a unique system of traffic regulation because of the fact that its principal business thoroughfares extend from the four corners of what used to be Court House Square. The court house no longer occupies the square and the area is a park. A master traffic tower occupies the center of the square and at the four points of the square are five-way automatically-operated and specially-designed traffic signals. These signals direct the flow of traffic, both vehicular and pedestrian, in every direction. Traffic lights suspended at each street intersection from special standards are also operated by the master tower. With this system one policeman directs traffic for the entire downtown area.

## Reconstructed Gutter Section Provides Additional Parking Space

THE city of Jamestown, N. Y., has recently inaugurated a system of street reconstruction which makes available, at small cost, much-needed automobile parking space. The streets, between property lines, are principally 70 ft. wide. The property line is 21 ft. from the gutter, which makes available for parking and traffic lines only 28 ft.. Repeated inquiries from the chief of police, in charge of traffic and parking regulations, as to what could be done, led the director




SLOPE REPLACES CURB TO FACILITATE PARKING

of public works of that city to consider breaking down existing street curbs to make the 15-ft. strip between gutter and sidewalk available for parking.

The curbs in the most congested sections of the city were therefore broken off or taken out entirely, and a concrete apron, 30 in. wide, put in its place. The apron was placed so that its edge nearest the sidewalk was as high as the top of the original curb had been. In places it was found simpler to replace both curb and gutter with a single concrete section. In either case with the new curved gutter section automobiles are run past the gutter until their front wheels rest against the outside edge of the sidewalk.

This reconstruction has a number of advantages. It releases to moving vehicles the entire between-curb width of the street, and gutters are not cluttered up through the accumulation of débris caught by automobile wheels resting against the curb. L. A. Bergman, city engineer and director of public works, estimates that the unpaved portion of the street which the automobile actually occupies is worth about $8, whereas the space it occupies in a paved street is about six times that amount. As a step toward getting greater service-value from the street the reconstruction is a good one.

Where such curb changes have been made the space to be used for parking is usually graveled and graded, so that the contour from the end of the apron to the sidewalk is even. The city of Jamestown put in, during 1924, approximately a mile of the new gutter at an average cost of $1.10 a lineal foot.

# *Engineering Work*

## Flexible Filing System for Engineering Data

BY JULIAN MONTGOMERY
Of Montgomery & Ward, Consulting Engineers, Wichita Falls, Texas

EARLY in the writer's professional experience there was felt the need of preserving, in a manner that would permit efficient future use, engineering data which are collected from one's own work, from technical journals, friends and miscellaneous sources. The obvious way was to bind the technical journals at the end of each year. This was done for a few years but in the main was unsatisfactory since much material of little use also must be bound; and data obtained elsewhere could not be disposed of likewise. Consequently different data were kept in different places, and since the writer had very little time to look after the material, there resulted a rather loose record of the technical information on hand.

The time came when there was an urgent need for technical information more up to date than could be found in textbooks. The material was on hand but could not be conveniently located. Following this exeperience the writer obtained a legal size filing drawer and some extensible file pockets and used them as a basis for a flexible filing system. (See Fig. 1.)

The accumulated matter was divided into the following subjects, and each subject with its subdivisions was lettered on the top and side of a pocket:

ACTIVATED SLUDGE
BRIDGES
- Foundations
- Timber
- General

BUILDINGS
- Beams and Girders
- Columns
- Footings
- Forms

CONCRETE
CONCRETE BRIDGES
- Arches
- Beams and Girders
- Culverts
- General

DAMS
DRAINAGE
FORMULAS
HINTS
- Drafting
- Forms
- Reinforcement
- General

IMHOFF DISPOSAL PLANT
MISCELLANEOUS
RECLAMATION AND IRRIGATION
ROADS
- Bituminous
- Brick
- City Pavements
- Concrete
- Gravel
- Maintenance
- Materials
- Tests
- General

SANITARY SEWERS
- Mains and Laterals
- Disposal

STEEL BRIDGES
STORM SEWERS
SURVEYING AND PLANNING
TESTS
- Concrete
- Steel
- General

WATER SUPPLY
CLIPPINGS
- Personal Articles
- Speeches by Writer
- Material for Articles
- Material for Speeches

Fig. 1 shows the rows of file pockets. Manila folders are used to hold the material filed under each subdivision, and the folders are filed in the respective pockets. Each folder is marked with the proper subject and subdivision as follows: "Roads—Concrete."

# *Of the Small City*

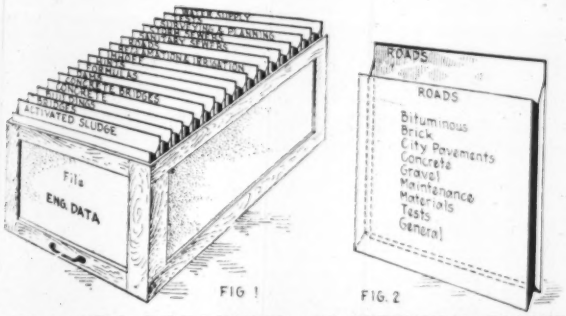



FIG. 1 FIG. 2

FIGS. 1 AND 2—FILE DRAWER AND EXTENSIBLE POCKET

Technical journals such as *Engineering News-Record* are culled periodically and such articles, together with any other data to be filed, are given the proper heading and subdivision as they are collected. Each article in the manila folder is numbered and indexed numerically, recording the title of the article (Fig. 3). This index card is kept in the front of the folder for the convenience of the user. On some rainy day when the office work is slack, the culled articles are properly numbered and indexed and then filed in the manila folder, which is placed in the extensible pocket.

There are two outstanding advantages to this system. First, its simplicity and compactness save time. Second, out-of-date articles may be discarded.

The following illustration is given: Suppose information on paving grades at street intersections is wanted. Referring to the subject index, it is seen that "City Pavements" is a subdivision of "ROADS." Taking the "City Pavements" folder out of the "Roads" pocket, and then removing the index card from the folder (Fig. 3), a glance shows that Article 8 is entitled "Grades and Street Intersections."

It should be stated that the subjects and subdivisions were chosen to fit the writer's particular file and they probably would be inappropriate for another's use. Also, it should be stated that such a file should not be compared to a library large enough to demand a librarian who can keep all the required information at the fingers' tips. However, for the average office, the file will prove very useful.

ROADS—CITY PAVEMENTS

| NO. | TITLE | REMARKS |
|---|---|---|
| 1 | Vibrolithic Pavements | |
| 2 | Corrugated Spacers | Wood Blocks |
| 3 | Foundation of St. Railway | |
| 4 | Excess Excavation | R.G. Tyler Method |
| 5 | Curbs | |
| 6 | Creosote Block on Pitch | |
| 7 | Sioux City Concrete Pavements | Finishing St. Car Crossings |
| 8 | Grades and St. Intersections | |
| 9 | St. Intersections - Steep Grades | |
| 10 | Concrete in Alleys | |
| 11 | Details Sioux City | |
| 12 | Roadway Surfaces at St. Intersections | |
| 13 | Computation of Paving Assessment | |
| 14 | Notes on St. Paving for Small Cities | |
| 15 | Concrete Slab Railway Grade Crossings | |
| 16 | Bituminous Foundations | |
| 17 | Pavement Crowns-Curbs Unequal Elevations | |
| 18 | Method of Determining St. Pavement Crown | |
| 19 | etc. | |
| 20 | etc. | |
| 21 | | |
| 22 | | |
| 23 | | |
| 24 | | |

FIG. 3—SAMPLE OF INDEX CARDS

## Smoke Abatement Activities in the City of Harrisburg, Pa.

INSTALLATION of stokers on power plant boilers and exercise of greater care in hand-fired boilers have done much toward the abatement of the smoke nuisance in the city of Harrisburg, Pa. Edward W. Gundel, Sr., chief of the Bureau of Smoke Regulation, has been largely responsible for the improved condition. Though the Bureau of Smoke Regulation cannot force the installation of stokers, it has advised them wherever possible and advised as to best installation methods. Wherever these installations are made, the conditions are immediately improved. In addition to a clean stack the saving in fuel and labor and the flexibility of operation make well worth while the initial investment.

One of the things which Mr. Grundel has had to overcome was the belief on the part of firemen that the more coal they fired and the more smoke they made, the higher the steam gage would register. With education these firemen have been convinced that by firing lighter they are not only able to maintain required steam pressure but they save themselves considerable work. An ordinance forbidding the use of high volatile coal in vertical-cylinder boilers, such as are used on steam shovels, hoisting engines, concrete mixers, etc., has practically eliminated nuisance from that source.

Though the city of Harrisburg is in the heart of the anthracite region, at the time of the impending coal strike of 1923 extensive use of soft coal and other hard coal substitutes became a possibility. However, the Bureau of Smoke Regulation made an investigation of the city's needs and advised as to the proper use of substitutes. Particularly did it advise the use of river coal, sufficient draft for its combustion (the coal being very finely divided) being supplied by individual blowers. Such blowers are becoming popular, several thousands already having been installed.

Though there is still room for improvement in the smoke conditions of the locomotives operating in and through Harrisburg the smoke nuisance from this source has been greatly reduced. Since the local bureau has no jurisdiction over public carriers in a third-class city, extensive instruction has been given railroad firemen on new locomotives equipped with stokers with the result that the nuisance has been greatly abated. Violations of smoke regulations on the Pennsylvania R.R. taken by the Harrisburg bureau are reported to the railroad's smoke inspector of the locomotive stationary boilers. That individual in turn follows the matter up with the fireman responsible. If three violations are reported against the same fireman, he is given a suspension of from two days to a week.

Inspections are made in the entire city of Harrisburg each week upon plants burning bituminous coal or any other fuel which may cause excessive smoke. In 1923 there were 2,451 such inspections.

Copies of Harrisburg's smoke-regulation ordinance can be secured from Mr. Gundel.

# Flow of Water in Tulsa 60-In. and 54-In. Concrete Pipe Line

## Tests for Friction Show Hazen-Williams' *C* of 152.4 in 15.3 Miles of 60-Inch Nearly Straight Pipe—Bends in Another Stretch and Loss Due to Venturi Meter Also Studied

By Fred C. Scobey

Irrigation Engineer, U. S. Department of Agriculture, Division of Agricultural Engineering, Berkeley, Calif.

TULSA, Oklahoma, is now receiving its water supply through the longest reinforced-concrete pipe line thus far constructed on this continent. (See "Manufacture of Pipe for Spavinaw Water Project," *Engineering News-Record*, May 22, 1924, p. 899.) Several features of this aqueduct, appearing to offer exceptional opportunity for extending existing knowledge of hydraulic losses in a concrete pipe line of the best modern construction, the writer recently made experiments on various reaches of the line from the Venturi meter near the Spavinaw dam to the outlet at Mohawk reservoir, some 55 miles away. These tests were all conducted with a view to determining so-called friction coefficients in various formulas for long reaches of new pipe, future measurements in later years being relied upon to discover any deterioration in capacity.

The tests gave highly favorable results. The value of *C* for Hazen-Williams' formula was 145.4 for 6.6 miles of 60-in. pipe having 29 bends aggregating 455.7 degrees; 152.4 for 15.3 miles of slightly sinuous 60-in. pipe, and 152.1 for 4 miles of nearly straight 54-in. pipe. The corresponding values of *n* in Kutter's formula were 0.0111, 0.0107 and 0.0106. Values for other formulas are given in what follow, as also loss-of-head values for entire reaches of pipe, the bends alone, and the Venturi meter.

*Pipe Line Layout*—From the gate-house in the end of the dam at Spavinaw Lake a 48-in. cast-iron pipe extends for 150 ft., including the length absorbed by a Venturi meter, to the upper end of a 60-in. reinforced-concrete pipe of the lock-joint type 147,590 ft. (28 miles) long; thence through horseshoe shaped concrete-lined Tiawah Tunnel, 6,950 ft. long in addition to approach and outlet sections that make a total length of 10,000 ft.; thence by a 54-in. concrete pipe exactly like the 60-in. pipe for the balance of the distance to Mohawk reservoir, 129,603 ft., or 24½ miles. The overflow crest of the dam at the intake is at El. 680, with an assumed flood plane at El. 686. The ridge at Tiawah Tunnel is so high that a uniform gradient from Spavinaw Lake to Mohawk reservoir was not feasible, hence the use of a 60-in. pipe from lake to tunnel and a 54-in. pipe under the steeper gradient from the tunnel to Mohawk reservoir. At the time of the tests water was just lapping over the crest of the dam at the intake end and falling over the weir in Mohawk reservoir at El. 606.5. The gates were wide open, hence the flow can be taken as the maximum capacity of the line for a reservoir level at the crest of the dam.

*Experimental Reaches*—Tests were made on four definite reaches of pipe. None were made at the tunnel as the velocity was only 1 ft. per sec., it being designed for the capacity of three similar pipe lines.

Reach 1, between gages 1 and 2, was a short length at the upper end of the 60-in. line, tested to determine the loss of head through the Venturi meter. Gage 1 was a mercury column of the U-tube type connected to the intake manifold of the Venturi meter. After passing the meter the water flows through 24 ft. of 48-in. cast-iron pipe, thence directly into the 60-in. concrete pipe. Gage 2, at Sta. — 10 + 10, was a water column in a gage glass graduated in tenths and hundredths of a foot, attached to a pet-cock in the body of an air valve on the top of the pipe 696 ft. from the end of the 60-in. main. Simultaneous readings of these two gages and gages 3 and 4, located further down the line, gave the loss of head per foot of pipe which must be deducted from the gross loss between gage 1 and gage 2 in order to get the net loss through the meter and 24 ft. of 48-in. iron pipe, and any loss due to the sudden enlargement from the 48-in. to the 60-in. line.

Reach 2, between gages 2 and 3, was a length of 34,788 ft. (6.6 miles) tested because it contained an unusual number of angular bends. The test on this reach, when compared by simultaneous equations with the test on the next reach, yields definite, positive information on the loss in the bends. These bends were 29 in number, aggregating 455.7 degrees. Two of them contained less than 5 deg.; 2, between 5 and 10 deg.; 7, between 10 and 15 deg.; 13, between 15 and 20 deg.; 4, between 20 and 25 deg.; and 1, 28 deg. These bends were formed by butting together two straight reaches of pipe at the angle required by the topography, and pouring a monolith of concrete over a heavy reinforcing cage around the joint. This was smoothed on the inside but remained distinctly a bend and not a curve.

This construction greatly reduced the cost of special castings. In the reach tested the large number of bends was made necessary by the many drainage crossings, bends being placed where the line broke over the rim on either bank and two more being required to join the slope reaches with the horizontal section laid across the stream or gully. Most of these bends are in the vertical plane, gentle curves in the horizontal alignment being made by opening small angles in each joint.

Gage 3 was a water column similar to gage 2, attached to a piezometer tube reaching just inside a service cock set in the top of the pipe at Sta. 327. This piezometer did not extend down into the flowing water prism, but was under the same dynamic condition as gage 2. In this reach of nearly 7 miles there was one rectangular "test tower" rising vertically over the pipe to an elevation above the maximum hydraulic gradient. In addition there were a few manholes, air valves, and several service cocks. Hydraulic losses caused by these are so insignificant that this reach may be taken as a slightly sinuous pipe except at the bends listed above.

Reach 3, between gages 3 and 4, was a stretch of pipe which offered an unusual opportunity for an accurate test of the loss in an open country trunk line, 60 in. in diameter. The total length between gages was 80,898 ft. (15.3 miles), of which the first 6 miles would still classify as gently sinuous line like the reach above, while the last 9 miles was fairly straight with long sweeping curves (Fig. 1). In the sinuous portion there

were 6 monolith bends aggregating 52.3 deg.—one of less than 5 deg.; 3, between 5 and 10 deg.; 1, 11½ deg.; and one approximately 18 deg. On the last 9 miles no angle between tangents exceeded 5 deg. and the curves were all made by opening the joints slightly over a long length of pipe. This reach contained two test towers and several manholes, service cocks, and air connections. Gage 4 was also a water column in graduated glass on the outside of a test tower at Sta. 1,137 + 54. The elevation of the water in the tower was transferred to the gage glass by means of rubber pressure tubing over the spill crest near the top of the tower. Inside the tower this tubing was attached to a 3-ft. ring of ¼-in. (¼ in. in diameter) iron pipe containing 22 holes. This manifold took off from the water surface in the tower at average elevation and brought it to the column in the gage glass. Pressures may be "siphoned" over low crests just as easily as flows, but the tubing must be "blown off" at frequent intervals; that is, the valves at the gage are opened and true siphonic flow is allowed for a short time, as the air in solution in water will work out under the rarified crest pressure and break the siphon. Of course the tube must be perfectly airtight.

FIG. 1—60-IN. PIPE LINE ON REACH 2

Reach 4, between gages 5 and 6, was a length of the 54-in. pipe 21,047.1 ft. (4 miles) long, near the lower end of the line, between Sta. 1,120 + 00 and Sta. 1,338 + 55. Both gages were mercury columns of the U-tube type (Fig. 2) connected by pressure tubing to piezometers extending ½ ft. into the water prism, through service cocks cast in the pipe during manufacture. The piezometers at the two ends of the reach were under identical dynamic conditions. In essentials they consist of brass tubing of ¼ in. inside diameter, sealed and rounded over at the end, with two pairs of holes bored with a 3/32-in. drill through both sides of the tube shell. These holes are ¾ in. apart, on the same lengthwise element of the tube, the lower pair being 1½ in. above the sealed end of the tube. This piezometer tube was 24 in. in total length with the upper 4 in. bent at right angles to form the short leg of an L. When this was aimed directly up or down the pipe line, then the pressure holes in the long leg of the L, inserted through a stuffing box into the concrete pipe, faced across the pipe line, neutral to the current. The stuffing box was made by simply boring holes through caps for ¾-in. nipples screwed into the service cocks. These holes fitted the brass tubing quite snugly and complete watertightness was secured by means of rubber washers compressing on soft string between them, and an iron carriage washer bearing directly on the top of the nipple. This reach on the 54-in. line is in all respects comparable with reach 3 on the 60-in. line, a higher velocity being attained with approximately the same quantity of water. The section shown in Fig. 3 was some miles above the straight reach tested.

*Hydraulic Elements*—The accompanying large table gives the hydraulic elements for the various tests, the essential quantities being determined as follows: For tests on the 60-in. line elevations of gage zeros were carried from the nearest existing benchmarks used on construction, the levelman having been field engineer for the city of Tulsa during location and construction. These checked within 0.1 ft. of the nominal elevations of the top of the concrete pipe, as taken from profile. The many lines of levels on location and construction furnished benchmarks acceptable for tests on long reaches of pipe. For short reach tests most carefully determined levels are necessary. Elevations of gages for loss of head at the Venturi meter and on the 54-in. line were determined by other engineers equally as competent as the levelman, who had been taken sick. Gages were read simultaneously every two minutes for periods of 30 min. or longer, the writer driving between gages meanwhile and personally taking the readings as he passed each gage to insure against lack of accuracy in readings due to any inexperience in such work. All gage readers were university trained civil engineers.

The loss of head for each test is the difference in elevation of the surface of water columns at the two ends of the reach, each elevation being taken as the mean of the various readings over the period of test. Where a mercury U-tube is used, the mercury differential is converted to the equivalent water column. (See p. 17, U. S. Dept. Ag. Bul. 852, cited below.) The quantity of flow, $Q$, was perfectly uniform for any one test as no changes were made in the gates at the dam during the week necessary for the tests and water continuously lapped over the crest of the spillway. At the lower end of the line slight changes in discharge elevation were made by use of flashboards, but these changes were made between tests and not during any of them. The flow through the new Venturi meter, less measured leakage in the line, was taken as $Q$ for tests on the Venturi and the 60-in. line. The Venturi calibration marks were checked by the water column manometers furnished with the meter. This check showed that the meter dial hand registered 100,000 g.p.d. more than it should, this error being 0.35 per cent of the dial reading of 28,750,000 g.p.d. The reach on the 54-in. line (No. 4) being some 52 miles from the meter, including unknown leakage losses through the 2-mile tunnel section, was computed by using $V$ as determined by timing the passage of an injection of fluorescein through the last 8,742 ft. of line. This color was forced into the pipe line through a stuffing box in a service cock about ¼ mile above gage 6. During this test water was wasted over a spillway at Mohawk reservoir. The passage of color was timed by stop-watch as from the moment of injection to the mean between first and last sight of the colored water at this spillway. This time and the known distance traveled gave velocity, $V$; and $Q$ is determined by the continuity equation $Q = AV$, where $Q$ is in cubic feet per second, $V$ is velocity in feet per second, and $A$ is area of water prism in square feet.

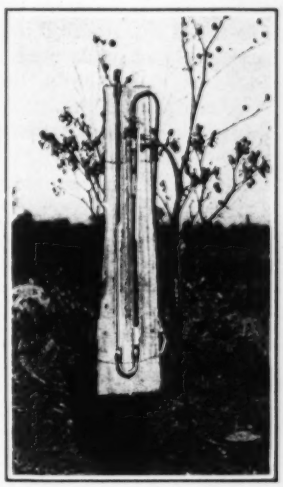


FIG. 2—MERCURY TUBE MANOMETER USED ON 54-IN. PIPE

The average areas of the 60-in. and the 54-in. pipe were determined by the writer by measuring two diameters at random points within 10 pipe units, each 12 ft. long, for each size. These units were located at various points along the line and were samples remaining after completion of the aqueduct. The smooth interior characterizing them is shown by Fig. 5. The measured average area for the 60-in. units was 19.630 sq.ft. against a theoretical area of 19.635 sq.ft., while for the 54-in. units the measured average area was 15.902

FIG. 3—NEARLY STRAIGHT TEST REACH OF 54-IN. PIPE

sq.ft. against a theoretical area of 15.904 sq.ft. These figures were so remarkably close that the nominal area was used in computations. The greatest variations occurred in one unit of 60-in. pipe that was 19.556 sq.ft. in area and one unit of 54-in. pipe that was 15.847 sq.ft. in area. It is to be noted that these diameters were not taken at extreme ends of units where the steel forms had been held by rigid mandrels, but at random somewhere near the centers of the 12-ft. units where the forms were more subject to slight distortions. The ends of all these units are controlled by mandrels on a tolerance of but $\frac{1}{16}$ in. in diameters (see Fig. 4). This absolutely removes all chance for offsets or shoulders so prevalent in many monolithic concrete aqueducts and particularly in precast-unit lines where the forms are stripped from the units before a rigid set has been attained. A few days before starting the tests here described, the writer was inside a similar 54-in. pipe line now serving the city of Denver, Colo. The Denver and Tulsa lines were made by the same methods if not actually with the same forms. At all joints tested a straight-edge spanning across the joints lay cleanly against longitudinal elements of the adjoining pipe units, no offsets whatever being found.

The essential data for the tests on the pipe reaches are given in the general table herewith.

*Analysis of the Data*—Reach 2, as stated above, was tested to develop the loss in the 29 bends. This is found below. Reaches 3 and 4 were tested for information to compare with formulas now used in computations. The lengths were so great that ever-present small errors of experimentation were completely overwhelmed by the actual elevation lost between gages (15.21 ft. for the 60-in. line and 6 ft. for the 54-in. line). These figures cannot but be very close to the truth. Likewise the diameters of the two pipes are unquestionable. They had contained water but a few days; their interiors must have been quite the same as in the samples examined and measured. The only slightly doubtful hydraulic item is the quantity $Q$. This is nearly always the most doubtful measurement, where long reaches of pipe are tested. The Venturi reading was approximately the same, day after day, during the tests. The corrected quantity as indicated by the dial reading of the meter was probably right, within the accepted 1 or 2 per cent accorded to this device by most authorities. From the dial readings the measured leakages were deducted for tests on the 60-in. line. The color velocity method employed at the lower end of the 54-in. line gave $Q$ equal to 41.82 sec.-ft. as against $Q$ at the Venturi, 52 miles away, of 44.20 sec.-ft., from which measured loss en route of 0.89 sec.-ft. leaves 43.31 sec.-ft. Hence by the color method there remained unaccounted for 43.31 — 41.82 = 1.49 sec.-ft. or 3.44 per cent of 43.31. Thus the computed coefficients for the 54-in. line are on the conservative side. Any other acceptable $Q$ would yield a higher $V$ and hence less conservative coefficients. Part of this 1.49 sec.-ft. is undoubtedly lost in the 2-mile, roughly-lined tunnel. As this tunnel is under pressure, it is quite conceivable that a large part of the discrepancy lies in this tunnel loss. Considering the length of the line, any unaccounted for difference between quantities determined by the Venturi and the color method are well within accepted accuracy for, say, current meters or commercial weirs (as distinguished from laboratory weirs). Unfortunately it was not feasible to secure tests at several velocities. The maximum flow was furnished for the tests, and any material lessening of the flow would have dropped the hydraulic gradient so that the line would not have been full at two or three summits.

As to retardation coefficients: For the sinuous 60-in. reach a value of $C_s$ of 0.402 was found for the writer's formula $V = C_s H^{.5} d^{.025}$, where $V$ is velocity in ft. per sec.; $H$ is loss of head in ft. per 1,000 ft. of pipe, and $d$ is internal diameter in inches. (For descriptions of all known experiments on capacity of concrete surfaced pipe, tunnels, and conduits see "The Flow of Water in Concrete Pipe" by Fred C. Scobey, Bul. 852, U. S. Dept. of Agriculture.)

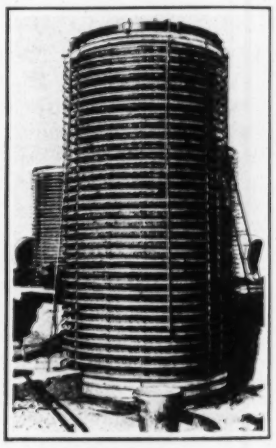


FIG. 4 — REINFORCING CAGE FOR 60-IN. PIPE

When the writer offered his formula for the flow in concrete pipes he divided these pipes into 4 categories and suggested (p. 8) a coefficient of $C_s$ of 0.370 . . . "for glazed interior pipe lines; . . . Particularly applicable to jointed lines of units made from wet, well spaded concrete, deposited against oiled steel forms and allowed to set firmly before forms are stripped. . . . A few of the pipes upon which experiments were made appear to have coefficients higher than 0.370, but the writer wishes to be conservative in recommending a coefficient that necessitates a surface so nearly ideal."

The specifications in the foregoing paragraph are perfectly adapted to the Tulsa pipe and the writer was not surprised when the experiments here described showed coefficients about 10 per cent above 0.370. Concrete pipe as made for irrigation use in the west coast states has a coefficient of about 0.310. The Tulsa line, with a capacity about 30 per cent greater, indicates the amount of improvement to be sought for in the

ELEMENTS OF EXPERIMENTS FOR THE DETERMINATION OF FRICTION LOSSES IN SPAVINAW AQUEDUCT, TULSA, OKLAHOMA.
Retardation factors in various formulas are also given. The conduit is a reinforced-concrete pipe, running full and under pressure.

| Reach | Inside Diameter In. | Alignment | Length Tested Ft. | Quantity (Q) M.G.D. | Quantity (Q) Sec. Ft. | Velocity (V) per Second Ft. | Elevations of Gradient, in Ft. Upper Gage | Elevations of Gradient, in Ft. Lower Gage | Loss of Elevation in Ft. Between Gages | Loss of Elevation in Ft. Per 1000 Ft. | Coefficients of Retardation: Scobey Cs | Hazen-Williams Cw | Chezy C | Kutter n | Weisbach f | Temp. Air Deg. | Cent. Water. Deg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 60 | Includes 29 bends... | 34,788 | 28.596 | 44.20 | 2.25 | 676.96 | 669.82 | 7.14 | .2052 | .386 | 145.4 | 140.5 | .0111 | .0130 | 14 | 16 |
| 3 | 60 | Slightly sinuous.... | 80,898 | 28.550 | 44.17 | 2.25 | 670.03 | 654.82 | 15.21 | .1880 | .402 | 152.4 | 146.8 | .0107 | .0120 | 15 | 16 |
| 4 | 54 | Nearly straight.... | 21,047 | 27.029 | 41.82 | 2.63 | 615.17 | 609.17 | 6.00 | .2851 | .409 | 152.1 | 146.9 | .0106 | .0119 | 8 | 12 |

irrigation pipe. When the loss due to angle bends is eliminated by simultaneous equations the coefficient in reach 3 becomes 0.403, which agrees as nearly as may be with 0.409 as found on the straight reach of 54-in. pipe, though reach 3 is more sinuous than reach 4.

As many engineers prefer to think in terms of certain specific formulas, the coefficients of retardation for those most used are given, though in the writer's opinion the only one, other than the above, having any merit for consideration in the study of concrete pressure pipes is the Hazen-Williams formula, which agrees quite closely with the writer's formula for the lower velocities but is not so conservative when velocities exceed 4 or 5 ft. per second.

*Loss of Head in the Bends*—By means of simultaneous equations, the loss due to bends alone may be found:

Loss in 34,788 ft. + 455.7 deg. of bends = 7.14 ft. (1)
Loss in 80,898 ft. + 52.3 deg. of bends = 15.21 ft. (2)
Multiplying (1) by 2.3254 =
80,898 ft. + 1,059.7 deg. of bends = 16.60 ft. (3)
Subtracting (2) from (3)
Loss in 1,007.4 deg. of bends = 1.39 ft.
Loss per degree of bend = 0.00138 ft.

Eliminating the bends from equation 2 above, we find the loss per degree of bend to be equivalent to the loss in 7.4 ft. of slightly sinuous 60-in. pipe, for a velocity of 2.25 ft. per sec. Realizing that many readers will object to the consideration of loss in say a 10-deg. bend or a 30-deg. bend as being 10 times or 30 times the loss in a 1 deg. bend, we may handle these equations in another way:

Loss in 34,788 ft. + 29 bends = 7.14 ft. (4)
Loss in 80,898 ft. + 6 bends = 15.21 ft. (5)
Multiplying (4) by 2.3254
Loss in 80,898 ft. + 67.4 bends = 16.60 ft. (6)
Subtracting (5) from (6)
Loss in 61.4 bends = 1.39 ft.
Loss per bend = 0.02264 ft.
Equivalent to the loss in 121.2 ft. of sinuous 60-in. pipe under a velocity of 2.25 ft. per sec., without bends.

There are very few actual empirical data on the loss of head in bends and curves and elbows that are not questionable. It is the writer's opinion that very little reliance can be placed in an experiment that embodies the use of piezometers at intake and outlet ends of such bends. If preceded by a reasonably long tangent then the intake piezometer will reflect accurate pressures but the water prism is so disturbed by a bend that the outlet piezometer is almost as liable to indicate a gain in pressure as a loss. Losses in bends, curves and elbows, to be unquestionable, must include a great aggregate angle, and simultaneous losses must be determined on a long reach of reasonably straight pipe or canal. With these data, by simultaneous equations, the unit losses, due to curvature, can be determined.

*Loss of Head in the Venturi Meter*—The writer feels about the determination of loss through a Venturi just as he does about curvature. It is true that the outlet tube of a Venturi tapers quite gently but it is also true that exceedingly high throat velocities such as prevailed in the Tulsa meter cannot be expected to regain their regimen of flow in any such short lengths as are found in a Venturi. With these facts in mind the upper gage was connected to the manifold at the meter intake, but the lower gage was placed 696 ft. down the 60-in. concrete pipe which began 24 ft. downstream from the lower end of the Venturi. The tests

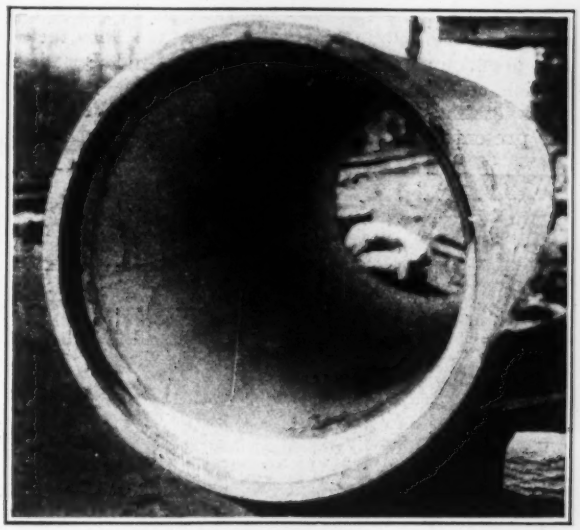


FIG. 5—PIPE UNIT FROM BELL END WITH LEAD GASKET

on the slightly sinuous pipe gave the data permitting deduction of the loss of head in the 696 ft. of concrete pipe. An abstract of the results follows:

| | Feet | |
|---|---|---|
| Average piezometer column elevation at gage 1, Venturi intake | 677.961 | |
| Velocity in 48-in. intake 3.52 ft. per sec. | | |
| Velocity head for V = 3.52 | 0.193 | |
| Elevation of energy gradient at Venturi intake | | 678.154 |
| Average piezometer column elevation at gage 2, on 60 in. pipe | 676.960 | |
| Velocity in 60 in. concrete pipe, 2.25 ft. per sec. | | |
| Velocity head for V = 2.25 | 0.079 | |
| Elevation of energy gradient at gage 2 | 677.039 | |
| Loss of head in 696 ft. 60 in. concrete pipe | 0.131 | |
| Elevation of energy gradient at intake to 60 in. line | 677.170 | |
| Loss at enlargement from 48 in. to 60 in. pipe | 0.027 | |
| Decrement in velocity head, 0.193 — 0.079 ft. | 0.114 | |
| Elevation of energy gradient at outlet 48 in. pipe | 677.311 | |
| Loss of head in 24 ft. of 48 in. pipe at velocity of 3.52 ft. per sec. Using Hazen-Williams coefficient of 130 for new cast-iron pipe | 0.018 | |
| Elevation of energy gradient at outlet to Venturi meter | | 677.329 |
| Net loss of head through Venturi meter | | 0.825 |
| Loss according to Hazen-Williams "Hydraulic Tables," p. 61 | | 0.775 |

This loss of 0.825 ft. appears excessive until the fact is considered that the throat velocity is 20.2 ft. per sec. for which the velocity head is 6.407 ft. The difference in velocity heads between throat and outlet is 6.407 — 0.193 = 6.214 ft. The net loss through the meter of 0.825 ft. indicates a recovery of velocity head of 5.389 ft. or nearly 87 per cent of 6.214 ft.

As a closing statement the writer wishes to emphasize the fact that the retardation coefficients found in the tests herein described are not to be used indiscriminately in the design of "concrete pipe." They require a continuous surface that is nearly ideal, so far as the eye can detect. Unless a pipe is to be made by methods that are truly comparable and with alignment that permits of gentle curves, then due allowance must be made on the conservative side.

# Pennsylvania R.R. Presents Plans For Philadelphia Station

## Main Passenger Terminal to Be West of Schuylkill River with Electrified Suburban Station Near Old Site

PLANS for the rearrangement of passenger terminal facilities which the Pennsylvania Railroad will make at Philadelphia, Pa., under the proposed agreement between the city and the railroad company were presented at a public hearing on May 20. They include the abandonment of the present stub-end Broad St. station and the construction of a large new through-track station in West Philadelphia near the site of the present West Philadelphia station, the removal of the tracks and elevated structure between the old Broad St. station and the river, the construction of an underground electrified suburban passenger terminal to the north of the present Broad St. station, the opening up of new streets east of the river, a large amount of new trackage and yard rearrangement west of the river to provide access to the new station, and the provision of sites for a new post office and an express building with direct rail connections.

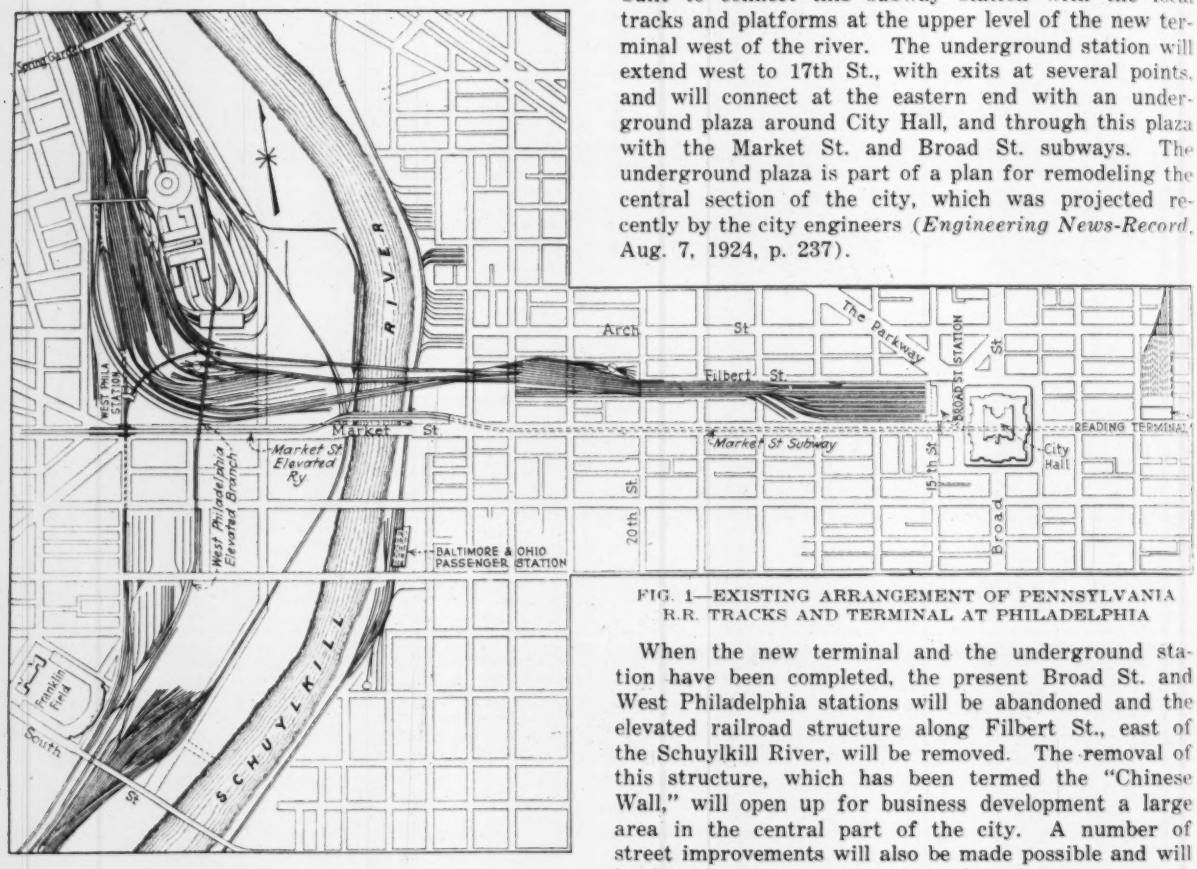



FIG. 1—EXISTING ARRANGEMENT OF PENNSYLVANIA R.R. TRACKS AND TERMINAL AT PHILADELPHIA

The main passenger terminal will be located on the west side of the Schuylkill River, between the river and 30th St., and immediately north of Market St. It will be a 3-level structure. The lower level, which will be just above the highest recorded river level, will be occupied with station platforms for through train service. Eighteen tracks are provided at this level. The street level will contain station facilities, comprising the concourse, waiting, dining, lunch and baggage rooms, etc. The upper level will have platforms for 8 tracks for local trains and, at the opposite side of the station, a station for surface and elevated trains to and from the Market St. subway.

The track facilities provided by the new station, with all through tracks, are to be compared with the 16 stub-end tracks now available in Broad St. station.

The station floor in the new terminal will occupy an area 580x770 ft. The concourse will occupy the greater part of the area inside the main building.

In addition to the construction of the new terminal, the railroad will build a 10-track underground station at 15th St., to be used for electrified service. A subway and a new bridge over the Schuylkill River will be built to connect this subway station with the local tracks and platforms at the upper level of the new terminal west of the river. The underground station will extend west to 17th St., with exits at several points, and will connect at the eastern end with an underground plaza around City Hall, and through this plaza with the Market St. and Broad St. subways. The underground plaza is part of a plan for remodeling the central section of the city, which was projected recently by the city engineers (*Engineering News-Record*, Aug. 7, 1924, p. 237).

When the new terminal and the underground station have been completed, the present Broad St. and West Philadelphia stations will be abandoned and the elevated railroad structure along Filbert St., east of the Schuylkill River, will be removed. The removal of this structure, which has been termed the "Chinese Wall," will open up for business development a large area in the central part of the city. A number of street improvements will also be made possible and will be done by the city. A new boulevard 90 ft. in width will be opened along the line of the present Filbert St. and over the underground tracks of the railroad. This new boulevard will lead directly from the Parkway at City Hall to the new terminal, and beyond it in West Philadelphia, and will be known as Pennsylvania Boulevard. The city will build a bridge over the Schuylkill River for Pennsylvania Boulevard. On the west shore of the river a new street will be constructed past the terminal to form an extension of the West River Drive from Spring Garden St. to South St. In the central part of the city, 15th, 16th, and 20th streets will be arcaded and widened.

The arrangement of the railroad tracks has been designed to secure the highest degree of flexibility in the operation of the new terminal. A loop to the south of the station will make possible the operation through

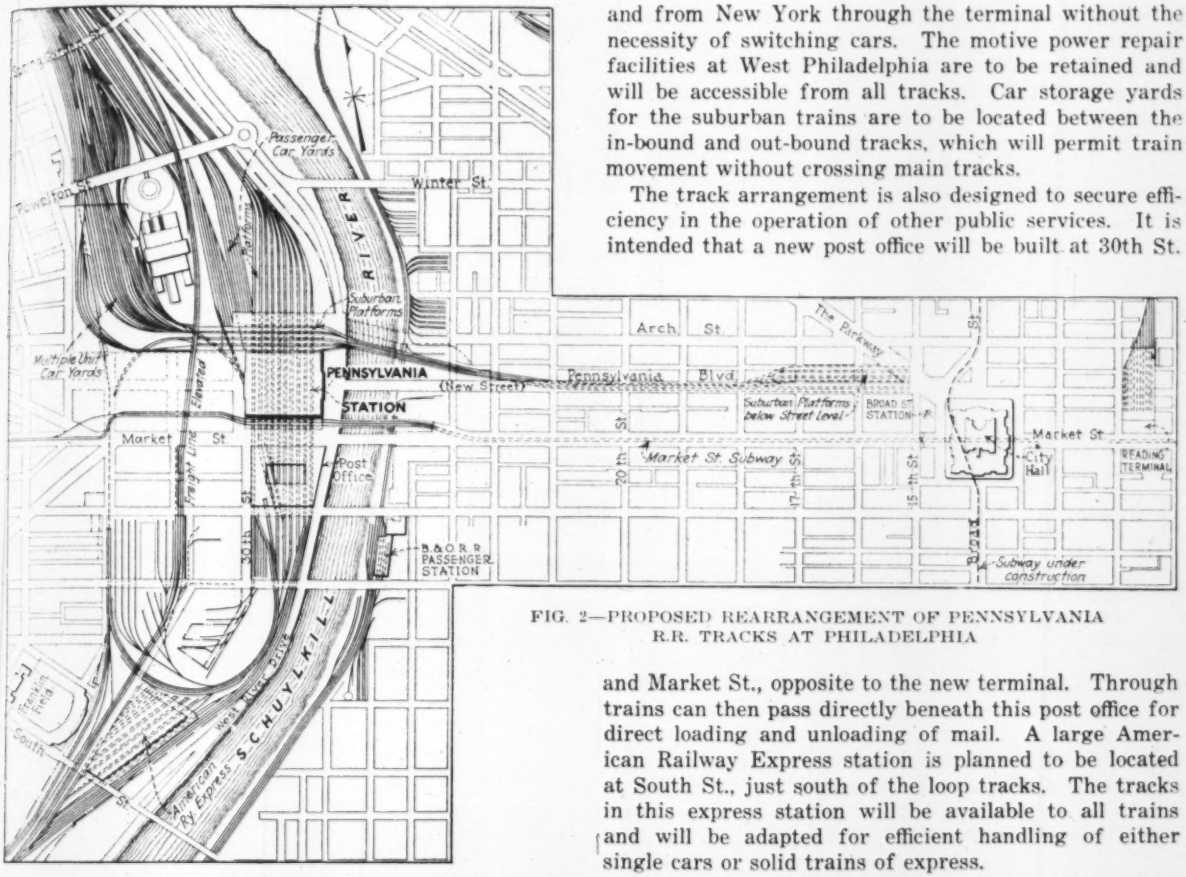



FIG. 2—PROPOSED REARRANGEMENT OF PENNSYLVANIA R.R. TRACKS AT PHILADELPHIA

and from New York through the terminal without the necessity of switching cars. The motive power repair facilities at West Philadelphia are to be retained and will be accessible from all tracks. Car storage yards for the suburban trains are to be located between the in-bound and out-bound tracks, which will permit train movement without crossing main tracks.

The track arrangement is also designed to secure efficiency in the operation of other public services. It is intended that a new post office will be built at 30th St. and Market St., opposite to the new terminal. Through trains can then pass directly beneath this post office for direct loading and unloading of mail. A large American Railway Express station is planned to be located at South St., just south of the loop tracks. The tracks in this express station will be available to all trains and will be adapted for efficient handling of either single cars or solid trains of express.

the terminal of trains between New York and the West. It will also permit the operation of trains to

The new terminal and other improvements will be built under joint agreement between the city and the Pennsylvania R.R. Co. The total cost is estimated to be $50,000,000, of which the city will pay about $16,000,000 for property and for construction of new streets and the adjustment of present streets to conform to Pennsylvania Boulevard. An ordinance authorizing the work has been prepared in joint conference between the railroad and the city engineers and is now before the city council, with a favorable recommendation by the mayor. If the agreement is acted on, it is expected that work will be started next year and will be completed ready for use in five or six years thereafter.

Plans for the work are being developed by the engineering department of the Pennsylvania R.R., under the supervision of E. B. Temple, assistant chief engineer. The station building is being designed by Graham, Anderson, Probst and White, architects, Chicago.

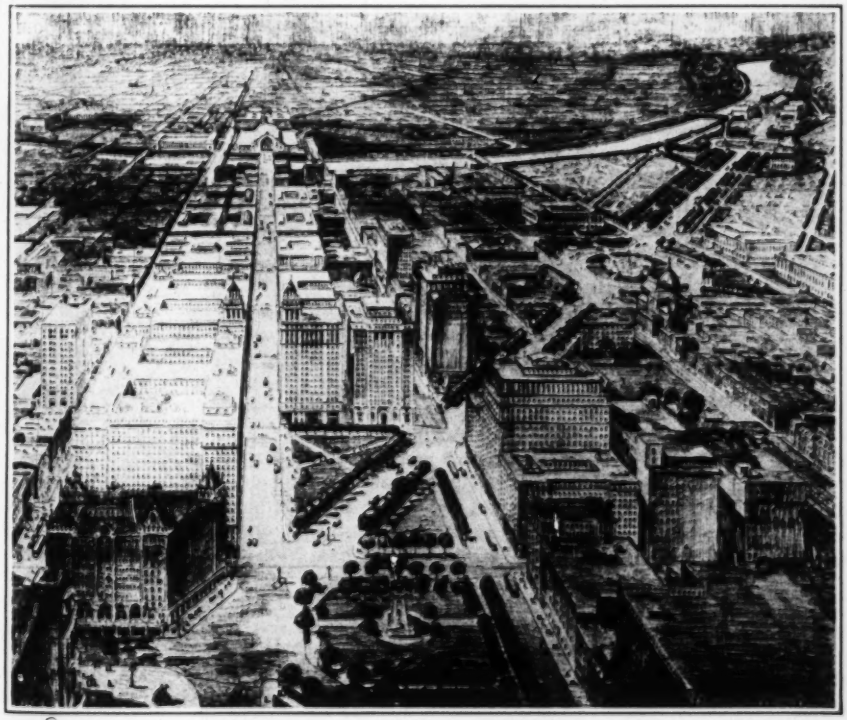


FIG. 3—PROPOSED PENNSYLVANIA BOULEVARD: VIEW TOWARD NEW TERMINAL
Head-house of old Broad St. terminal in the left foreground; behind it, released area.

# Commerce Chamber Discussions of Interest to Business

## Annual Meeting of the Chamber of Commerce of the United States Devoted to National and International Economies and to Matters of Importance to Municipal Engineers

AT THE annual meeting of the Chamber of Commerce of the United States in Washington, May 20-22, a major part of the proceedings was devoted to subjects of interest to engineers. Brief outlines are given below of the more important of the discussions.

*Civic Development*—Problems of civic development as related to metropolitan traffic, city planning, building construction and home ownership, the first dealing especially with such systematic layout as will bring proper functioning of utilities, were considered in papers presented before group meetings.

The speakers were: Dr. John M. Gries, chief of the Building and Housing Division, Department of Commerce, "The Building Congress—Its Purposes and How It Is Achieving Them in Five Cities"; Thomas Adams, general director of plans and surveys, Regional Plan of New York and Its Environs, New York City, "Economic Use of Land in Urban Communities"; and Morris Knowles, civil engineer and city planner, Pittsburgh, "Housing in Relation to Citizenship."

Dr. Gries told of the experiences in New York, Boston, Philadelphia, New Jersey and Oregon in the organization of all interests concerned with the construction industry into building congresses to cooperate in problems common to all jurisdictional disputes among labor and differences among builders, supply men, etc. The congress must be purely local to succeed, he said. Settlement of differences by arbitration he mentioned as one of the important aims. Governmental agencies should not undertake work of this character unless private industry defaults, Dr. Gries said. He urged building interests to confer in each community regarding the construction program in order to avoid peaks and valleys and thus stabilize conditions.

"Efficiency is born of order and beauty," asserted Mr. Adams, who declared that city planning means more than to devise means of moving streams of automobiles through the streets.

Mr. Adams emphasized the necessity of sound zoning laws to control development of urban property. He cited specific instances of excessive taxation due to lack of a plan in developing a city's growth. Transportation, sewage, electric and other utility systems often are unnecessarily wasteful because of haphazard development, he said. He advanced the suggestion that it would be more profitable to use some suburban properties for agricultural purposes until conditions justified improvement than to permit them to lie idle until this time arrived. Land must increase 10 to 15 per cent in value annually in order to justify investment in its development, he said. He told of experiences of some cities which laid costly public service lines without ability to put them to use.

Mr. Knowles urged home ownership to bring improved citizenship. The great question is proper financing, he said. Operative-builders offer the best hope to stop the decline in home ownership, he said, pointing out evils in government assistance and in industrial home-building.

The principal interest was shown by the delegates, judging from the questions, in zoning regulations and in the financing of home construction. Corporations organized by chambers of commerce to buy second-mortgage notes from home-builders were endorsed by applause. Questions regarding zoning laws centered around their constitutionality, it being brought out that Massachusetts and California supreme courts recently have upheld such laws and that test cases are on the way to the United States Supreme Court.

Higher buildings and greater concentration of business in American cities were described as symptoms of economic waste, rather than monuments of business achievement, by Harland Bartholomew, city plan engineer, of St. Louis. He said that every city should approach its traffic problems by first adopting and enforcing a regional and city planning scheme providing for complete industrial, commercial and social organization of its entire area. Traffic congestion occurs in very limited spots in every city. Rigid limitation of building heights and a reasonable spreading of crowd producing businesses in congested centers is the fundamental step in solving the metropolitan traffic problem. Higher and higher buildings and ever greater concentration of business are not so much monuments of business enterprise as they are symptoms of economic waste.

The second step in meeting the metropolitan traffic problem is the design of an adequate street system throughout the present and future area of the city and its region. The third step is proper traffic regulation.

Awards for the Inter-Chamber Fire Waste Council were made to Indianapolis, Ind., Fresno, Calif., Findlay, Ohio, and Albany, Ga., for leadership in their respective classes for good fire prevention during the year 1924.

*German Reparations*—A plan has been devised to get wealth out of Germany, without disrupting industry in other countries, it was reported. The idea is to apply German production capacity to wealth-creating enterprises, particularly in countries where development has been retarded. Were Germany to furnish the materials and supplies for a railroad which would make possible the opening of new mines, new forests and new agricultural wealth, to cite an example used by Julius H. Barnes, no market would be taken away from any one. New peoples would acquire buying power, new wealth would be created and the world would benefit. This was held to be vastly superior to the dumping of goods for current consumption upon an amply supplied market which would mean the displacing of the output of plants in other countries; but confining German effort largely to that type of production which represents large proportions of German iron, German coal and German labor, is better than having Germany import raw material for manufacture and then export the same material, plus a small value added by the manufacturing process, Mr. Barnes contended.

*Trade Commission Reform*—A domestic development regarded as of encouraging and far-reaching import was the announcement of a new creed by the Federal Trade Commission. It reads: "We do not believe that

success is a crime. We do not believe that failure is a virtue. We do not believe that wealth is presumptively wrong. We do not believe that poverty is presumptively right; We do not believe that industry, economy, honesty and brains should be penalized. We do not believe that incompetency, extravagance, idleness, and inefficiency should be glorified. We do not believe that big business and crooked business are synonymous. (True we will give closer scrutiny to big business than to small business, because of its greater power for good or evil.) We believe that 90 per cent of American business is honest. We believe that 90 per cent of American business is anxious to obey the law. We want to help this 90 per cent of honesty. We want to control or destroy the 10 per cent that is crooked."

*Waste in Government*—Herbert Hoover addressed the meeting on "Waste in Government." He considered only those wastes which arise from improper organization and from a mixing of administrative functions with those of a semi-judicial and semi-legislative character. He declared that there was need for three primary reforms: First, to group together all agencies having the same predominant major purpose under the same administrative supervision; second, to separate the semi-judicial, the semi-legislative and advisory functions from the administrative functions, placing the former under "joint minds"—that is, boards, commissions and committees—the latter under single responsibility; third, to relieve the president of a vast amount of direct administrative labor by putting the independent establishments now reporting to him into the existing executive departments.

As an indication of the wastes in separating agencies having the same major purpose he showed that public works construction is now performed by fourteen bureaus scattered through nine departments, that the conservation of natural resources is covered by eight bureaus in five departments, and that there are direct aids to the merchant marine in fourteen bureaus in six departments. This scattering results in constant conflict of view with the government itself, preventing the formation of a definite and consistent policy. At the same time needless expense is imposed upon the public in seeking the information it wants, settling the demands upon it and determining the regulations by which it is required to conduct its business. Within the government itself there is also obviously waste of the taxpayers' money.

Congress has from time to time imposed semi-judicial and semi-legislative functions upon executive departments or independent establishments and these functions and administrative work have become hopelessly mixed. The Shipping Board is a glaring example of ineffectiveness arising out of such mixture of functions. Mr. Hoover cited the semi-legislative functions of the Secretary of Agriculture in the administration of the stockyards and commodity exchanges as another unfortunate instance of mixing semi-legislative and administrative functions. Every department, bureau and board should be examined and a separation made between the semi-judicial and semi-legislative functions on the one hand and administrative on the other. The former rightly belongs to boards or commissions, the latter to individuals.

Legislation has imposed upon the President no less than forty independent establishments which are supposed to function directly under the President. It is preposterous to expect the President to give them anything like adequate supervision. These establishments conduct their activities with very little supervision or co-ordination. Such of them as have straight administrative functions expend nearly half a billion a year —as much as the total of five of the departments under cabinet officers. If for no other reason this group should be placed directly in some department where they may have proper administrative guidance and control.

Finally, Mr. Hoover objected to further expansion of federal authority, as against state authority, except where constitutional inhibitions prevent state solution or where overpowering and destructive action would result to local communities unless there were federal control.

## Pennsylvania Water Supplies Protected Against Coal Mine Wastes

A DECISION of the Pennsylvania Supreme Court declaring the discharge of acid coal mine wastes into public water supply to be a nuisance which must be abated by July 1 of this year was reported at the Louisville convention of the American Water Works Association by Almon L. Fales, chairman of the Committee on Industrial Wastes in Relation to Water Supply. The decision reverses the Fayette County court in the same case, reviewed at length in a progress report of the committee, published in 1923 (Journal A. W. W. A., Vol. X, p. 417). The suit was originally brought by the Mountain Water Supply Co., the Pennsylvania Railroad Co. and others to restrain the Melcroft Coal Co. and some twenty other companies and individuals from polluting Indian Creek with drainage from a number of coal mines. The lower court held that to stop the pollution would deprive the mine owners of their rights without due process of law. The higher court ruled that the mine owners "have no right of any kind to drain their mine waters into the stream, considering the public use which is made of its waters"; also that the Sanderson case, which for years past has been considered as governing in favor of mine owners, did not apply in the case on appeal.

George W. Fuller, in the discussion of the paper, characterized this decision as the most important for the protection of public water supplies ever decided in the United States. He also said that without the reversal a $10,000,000 water-works property, with 45 miles of pipe line, would have been wiped out by its water supply becoming unusable. Nothing definite has yet been done to stop the mine waste pollution.

## New Railway to Be Constructed in Australia

Specifications are now under preparation prior to the calling of tenders for the construction of a line from Kyogle, New South Wales, to South Brisbane, which is to form a part of the uniform gage scheme. It is estimated that the work will involve an expenditure of $16,800,000. Of this amount the Federal Government will subscribe $9,600,000; New South Wales, $5,300,000; and the Queensland Government, $1,900,000. In connection with the building of this railway line, it will be necessary to bridge the Clarence River, which, it is estimated, will cost $2,400,000 and will be carried out by the local state government.

# From Job and Office

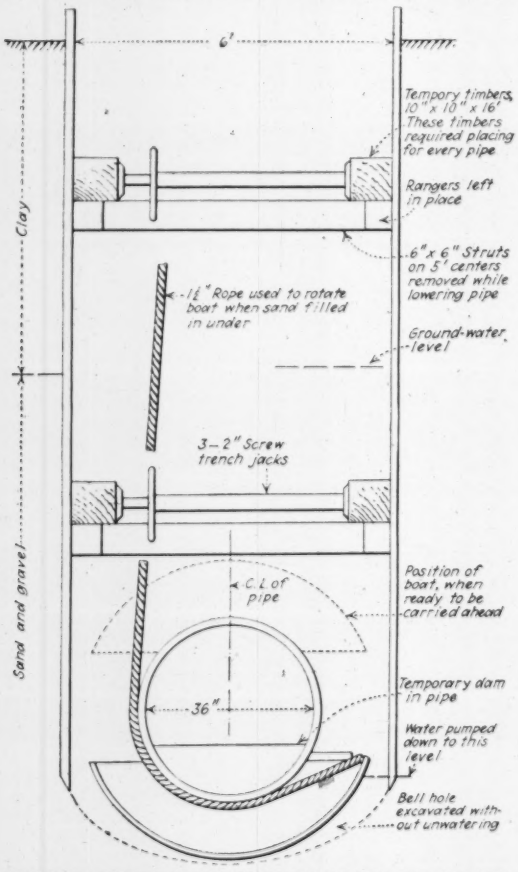
## *Hints That Cut Cost and Time For the Contractor and the Engineer*

### Cofferdam Used in Bell Holes for Jointing Pipe in Wet Trench

By Samuel P. Baird
Engineer and Contractor, Columbus, Ohio

SOME time ago the writer had occasion to lay some 36-in. Class C cast-iron water pipe in a trench which was below ground water level. The trench had been close sheeted with 2-in. plank placed vertically with two lines of rangers. The bottom of the sheeting was at, or slightly above, the elevation of the bottom of the pipe.

The normal ground water elevation was about 8 ft.


6'
Tempory timbers, 10" x 10" x 16'. These timbers required placing for every pipe
Rangers left in place
6" x 6" Struts on 5' centers removed while lowering pipe
1½" Rope used to rotate boat when sand filled in under
Ground-water level
Clay
3—2" Screw trench jacks
Sand and gravel
C. L. of pipe
Position of boat, when ready to be carried ahead
Temporary dam in pipe
36"
Water pumped down to this level
Bell hole excavated without unwatering

TRENCH SECTION SHOWING PLACING OF "BOAT"

above the elevation of the bottom of the pipe. The sheeted trench and the area outside the trench had been unwatered by continuous pumping with a 6-in. centrifugal pump. Bell holes could be dug in the bottom of the trench, but any attempt to pump them out caused sand and gravel to run in from under the sheeting.

Two days were spent in yarning, leading and calking one joint. A plan was thought out during the evening of the second day which worked very successfully. Before the pipe was lowered the bell hole was dug and a small cofferdam was sunk in the excavated hole. The pipe was lowered and placed in position. A temporary wood dam was placed in the end of the pipe being laid. There were two of these dams in use—one in the pipe already laid to prevent the water backing into it, the other in the pipe being laid. The cofferdam was then bailed out. The buoyancy of the boat (as the men termed it) pressed it against the pipe making a watertight joint by means of two strands of rope oakum nailed on the contact surface. The pipe joint was then yarned, the lead poured, and the calking done in the dry.

On completion of the calking, the boat was filled with water and rotated around the pipe and then lifted off. Sometimes the sand would fill in under the boat, making it hard to rotate. In this event, a 1½-in. rope was passed under the pipe outside the boat then over the end of the boat and back under the pipe. The ends were attached to one of the two ton chain blocks used to lower the pipe and the boat rotated by the power of the block.

Twenty-four joints were laid with the boat at a speed of three pipes per day with a gang of eight men.

The rangers were not placed as systematically as shown in the sketch. Often the bottom rangers would be too low and had to be raised so the 6x6 struts would clear the pipe.

The boat was 4 ft. long, the ends were of 1¾-in. plank, the bottom ¾-in. narrow flooring (painted both sides before placing). The corners were well banded with No. 24 galvanized iron, cut in 2-in. strips.

### Water Colors for Topographic Maps

By Clair V. Mann
Rolla, Mo.

ANY engineer whose work involves the preparation of tracings or photostatic copies of topographic maps has doubtless been very much annoyed when he has attempted to obtain blue prints or photostatic copies from tracings made in color with the use of commercial so-called "waterproof" inks.

After an extended experience in the drawing of topographic maps of an intricate character in color, the writer has found that very satisfactory reproduction can be made if the colors employed are: (1) burnt sienna water color (darkened with lampblack water color to the desired shade of brown) for contours; and (2), prussian blue water color for streams. Both of these colors, if mixed to a fairly thick consistency, as can be used advantageously in a ruling pen or contour pen, will make a first-class blueprint and excellent photographic reproductions.

In the matter of resistance to water the writer believes that the water colors, when dry, are superior to the commercial colored inks. The following occurrence bears out this opinion. The writer had prepared some elaborate topographic maps employing commercial so-called waterproof colored inks, the drawing being made on a good quality of double-mounted drawing paper. It became necessary to paste several small sheets together to make sheets of larger size. One surface of the double-mounted paper was ripped away and the drawing, left on the other surface, was then pasted

down on larger sheets of the required size. The assembled sheets were placed in a press for drying. When removed from the press those sheets on which the commercial inks had been used presented the appearance of a blotter—ink for the contour lines had spread out into the paper on each side. In contrast, the sheets on which the water colors had been used and which were subjected to the same process of pressing and drying came from the press with no defects.

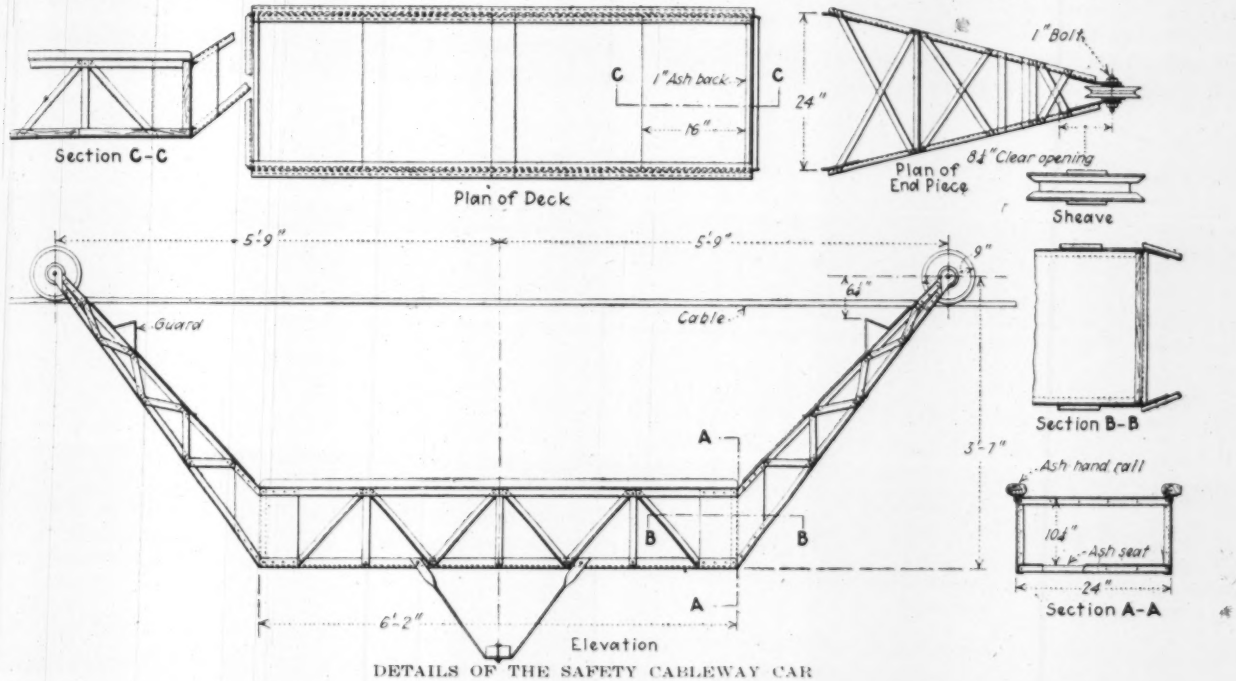
## Cable Ferry Car of Safe Design for River Crossing

IN connection with the extension of a transmission line, the Portland Electric Power Co. found it necessary to install cable crossings at 14 points along the Clackamas River in Oregon for transferring men and materials to the bank opposite that on which the railroad is located. The ordinary type of cage used by stream gagers and others who improvise carriers for use on cables of this sort has a serious disadvantage in the danger of injuring the hand between sheave and cable. Accordingly a special design was worked out for a car suitable for this job as thus described:

The cables were ¾ in. in diameter and the car itself was designed for a 1,000-lb. load thus making it possible to ferry heavy material for use in line construction. The cars weigh about 165 lb. each and except for the seats, handrails and footbar are made entirely of galvanized iron at a cost of about $75 each.

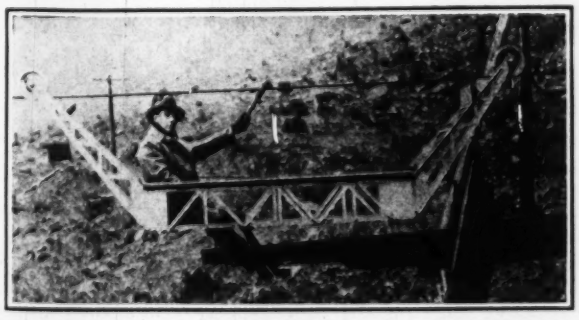
The ends of the car as shown in the accompanying drawing are carried out some distance instead of being brought up vertically from the body, thus putting the sheave well out of reach of the operator. As an additional precaution the light bent plate shown near the sheave was put in to loosen a man's hand on the cable before it could be caught by the sheave.

The car is propelled by the clamp or "puller" shown in the illustration. This can be slid along the cable when in a position at right angles to the wire and grips the cable when pulled at an angle.




DETAILS OF THE SAFETY CABLEWAY CAR

The car was designed by C. C. Galbraith, chief structural draftsman, Portland Electric Power Co.



STEEL CAR ON CABLEWAY AT LANDING

## Joint Between Penstock and Saddles Made of Asbestos Paper

IN THE penstock line serving the Moccasin Creek plant on the Hetch Hetchy project the concrete saddles are separated from the penstocks they support by two thicknesses of asbestos paper which was painted with liquid graphite before being put in place. The use of a single thickness of building paper which was tried at first was not satisfactory as the paper moved with the expanding pipe and, as contraction occurred, would not go back between pipe and support.

Two thicknesses of the lubricated paper, on the other hand, are effective because the upper piece tends to cling to the pipe while the irregularities of the concrete hold the lower piece, thus allowing a slippage of the smooth surface between the two sheets. Before being filled this pipe moved as much as 2½ in. in some saddles as the result of temperature changes.

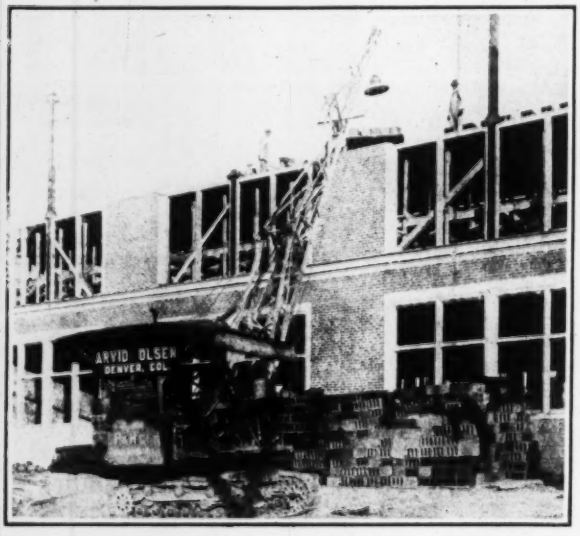
When the pipe sections were put in place, only the central portion of the concrete saddles, about 8 in. wide,

had been brought up to line and grade. The remainder of the saddle was left about 1½ in. below grade. After the pipe had been filled, forms were placed on both sides of the saddles and this space underneath the lower paper was filled with grout and tamped well into place so as to provide a support of a shape suited to that assumed by the pipe when under water pressure.

## Portable Crane Handles Building Materials at Big Cost Saving

IN building the East Denver High School, at Denver, Colorado, the contractor met the difficult problem of hoisting structural material and tile for a building of H shape, covering a very wide area and having an outside wall of 2,200 lin.ft. The contractor erected two building hoists, but the great bulk of tile, brick and terra cotta made it impossible to pile all of this material so that it could be moved quickly to the point where it was needed.

To solve this problem, he used a crawler crane with a 15-ft. boom extension, giving a 53-ft. boom length. With this machine, it was possible to handle the major portion of the tile, covering the 250,000 sq.ft. floor area, the form lumber and reinforcing steel, the window frames, structural steel, about 25 per cent of the brick for the walls and some terra cotta. In handling this




TRAVELING CRANE PLACING TILE NEAR THIRD STORY LEVEL

material, the crane was able to move all about the building, pick up the trays of material directly from the ground and place it on the building where required by the workmen. Each tray held 25 tile, or an equivalent of four wheelbarrow loads, thus the crane, operated by one man, handled what would ordinarily require four men with wheelbarrows and the time required was considerably less than required with the wheelbarrows. In handling the structural steel, terra cotta and framework, the machine not only hoisted the material directly to the spot where it was to be used, but also held it and lowered it into place, without any physical effort by the workmen.

In calculating the cost of the erection of this building, the contractor, Arvid Olsen, found that his costs had been reduced 50 per cent for handling the tile and 70 per cent for handling the reinforcing steel.

The crane used in connection with this work was built by the Harnischfeger Corporation, formerly Pawling & Harnischfeger Co., of Milwaukee, Wisconsin, from whom this information was secured.

# From Job and Office

## *Hints that Cut Cost and Time*

## Standardized Formwork for Reinforced-Concrete Lintels

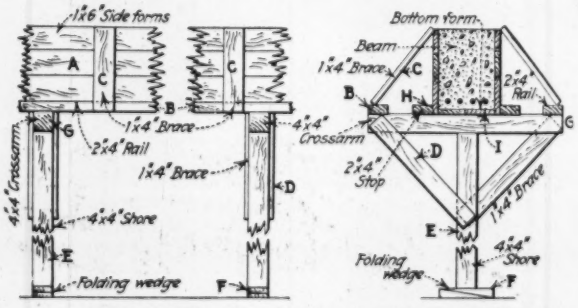
BY ROY M. SINGER
Civil Engineer, Chicago, Ill.

ONE of the most important items in reinforced-concrete construction is the erection of the formwork. It is a common saying among contractors of long experience that forms may turn a profitable job into a losing one. A slight change in formwork erection may mean a big difference in the cost of the job. There are practically endless ways in which formwork for a reinforced-concrete lintel of large dimensions may be erected. One way may require more lumber but it may save on erection costs. Another may permit the use of less lumber but increase the labor cost. A third may call for a minimum of lumber and of labor but may fail to provide sufficiently for salvage of formwork for reuse.

In the sketch shown herewith some contractors and engineers may recognize an old friend. To others it will be new. While the writer has seen it on a few jobs, its use is not as widespread as it may be. Its utility from the standpoint of economy of material and labor, its high salvage value and the ease with which it may be taken down should recommend it.

In the sketch shown here the shores (E) are 4x4-in. section with a 4x4-in. crossarm (G) at the top, stiffened by 1x4-in. braces (D) nailed to the shores. Folding wedges (F) are set under the shores in order that the beam forms may be leveled before pouring begins. To keep the crossarms in line, 2x4-in. rails (B) are set at each end of the crossarms and nailed in place. Thus the shores are prevented from turning and the entire formwork system is stiffened. The side forms (A) which mold the side of the lintel are built of 1x6-in. pieces, cleated together; also (I), the bottom piece.

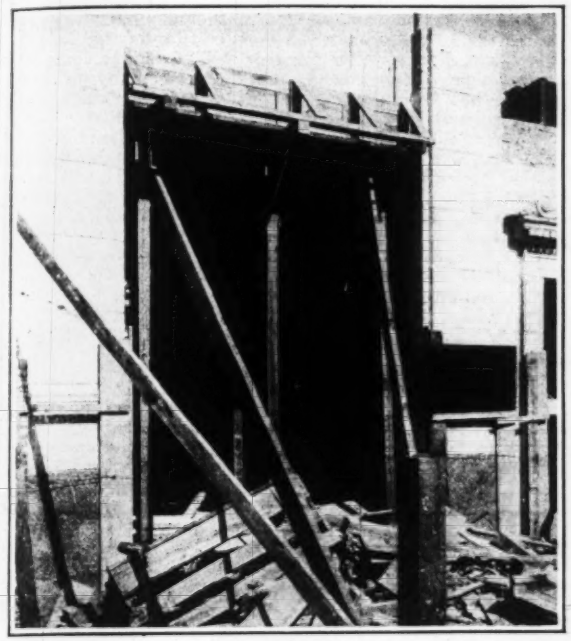
When erecting this formwork the shores with the crossarms and the braces attached are set up and held with the rails. Next, the 2x4-in. stops are set across the crossarm so that the inside faces of the stops are a distance apart equal to the width of the lintel




DETAILS OF FORMWORK FOR CONCRETE LINTELS

# From Job and Office

*For Contractor and Engineer*



LINTEL FORMWORK IN PLACE

plus twice the thickness of the lumber used for the sides. The side forms and bottom form are made to the proper size so that they may be set in place without the necessity for any cutting and fitting.

It should not be necessary to nail the side forms and the bottom form to each other if the cutting has been correctly done. Simply set the bottom form on the crossarms between the stops and place the side forms between the edges of the bottom form and the inside face of the stop, where they should fit tightly if it has been properly made. The side forms may then be braced with 1x4-in. braces running from the rails to the top of the side forms.

Aside from the simplicity of erection there is the ease of demolition to be considered. If moderate care is used in wrecking, this system of formwork should provide close to 100 per cent salvage, as each piece is taken down in the reverse order in which it is set up and it is unnecessary to break any unit in the assembly.

## Relocating a Road With Speed a Principal Consideration

By Royden E. Reed

Assistant Engineer, L. H. Shattuck, Inc., Manchester, N. H.

SURVEYS made for the development of a storage reservoir indicated that a highway had to be relocated. In order to have data to present at a town meeting which would authorize relocation it was necessary to stake out, as closely as possible, the final road relocation. Thick underbrush with summer foliage, lack of time and labor prohibited the thorough layout necessary to give, visually, a good idea of the relocation. The relocation ran practically parallel to our stadia traverse line and the following scheme was devised for quick location:

In the office the road was plotted on our topographic map. From each traverse station the distance to the relocation was scaled, right or left, along a line perpendicular to the traverse line ahead. From the points on the relocation thus found, the distances to points of curvature and tangency were scaled and noted. (Tangent distances were assumed.)

In the field one man went to a traverse station with one end of a tape, lined a second chainman in as nearly perpendicular to the traverse line ahead as possible, and at the proper distance set a stake. Stakes showing points of curvature and tangency were then located in conformity with scaled distances. This was accomplished for the full length of the relocation, about 3,100 ft.

Starting from Sta. 0+00 and observing his position every few feet on the map, one man walked along unwinding twine from a large ball as he progressed. He was able to range himself in by the shouts of a second man who preceded him from stake to stake. Curves, where necessary, were smoothed out and the line generally "touched up" on the return trip. The white twine was very easily followed and proved to be a great help.

This entire procedure occupied less than half a day and the subsequent survey for the actual road building indicated that the greatest error did not exceed approximately 3 ft

## Job and Office Notes

**Two Hundred Derrick Towers Used** in war-time erection of ships at Hog Island have been demolished by a crew of a dozen men, the total time for demolition being four months. The work was done in a simple fashion, the old lumberman's method of falling timber being simulated. Towers were about 20 ft. x 30 ft. in ground plan by 50 ft. high and were cut down and reduced to sizes small enough to ship in gondola cars. They were not dismantled piecemeal, but dropped toward the track paralleling each way by cutting through two diagonally opposite columns. The column away from the track was first cut entirely through with an oxyacetylene blowpipe at a point about 6 ft. above the ground. Then the column toward the track was nicked at a point nearer the ground. Segments were first cut through the flanges in the web of the columns which were H-shaped and built up from plates and angles. The V-shaped notches were cut in the web next and final cutting was done by the blowpipe held in an extension handle improvised from pipe so the operator could keep away from the column in case it buckled locally. The uncut columns controlled the tower's direction of fall.

**An Airplane Is Being Successfully Used** by the B. M. Brooks Construction Co., Dallas, Texas. It is found an excellent machine for a contractor whose contracts are rather widespread and need personal supervision. As an indication of its utility in urgent cases, the following paragraph is taken from a recent issue of *The Earth Mover*: "This firm was doing some work in Denison, 100 miles from Dallas. At 4 o'clock one afternoon the thread from the axle of a tractor being used on the job was stripped. The men in charge promptly telephoned to the Dallas office, then plugged the axle and managed to work until 5 o'clock before breaking down entirely. Meanwhile, a new axle was secured and balanced on the wing of the airplane. Then Jack Brooks started with his plane tipping rather perilously under the weight of the 300-lb. axle. However, he delivered the axle, watched the men put it on and was back in Dallas by 2 o'clock in the morning. The tractor went to work at 7 a.m. as usual, and the entire time lost on the job was only one hour between 5 and 6 in the afternoon."

# Letters to the Editor

***This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.***

## Probability Methods for Rainfall and Runoff

Sir—The gradual adoption of probability methods for arriving at the risk or chance of occurrence of such events as rainfall and runoff seems ground for calling attention to an exceedingly common error in the selection of magnitudes indexing the chance.

If we let

$F$ = Frequency or interval in years between events of given or exceeding magnitude;

$T$ = Total number of observations in a given series, one representing each year of the period covered by the data;

$N$ = Numerical designation of an observation when the series is arranged and observations are numbered in the order of magnitude beginning with the least;

$$F = \frac{a}{b - N};\ \text{in which } a = T + 2\frac{T-1}{T-2} - 1;$$

$$\text{and } b = T + \frac{T-1}{T-2}$$

These relations are based on the fact that the magnitude for the center of the series has a frequency of once in 2 years and the frequency of the maximum observation is represented by $T$, the total number of observations or years.

The following tabulation of values for 10 observations, representing 10 years in series, illustrates possibly better than any argument the logic of these relations, the last column showing $1/F$ or probability percentage for this purpose:

$T = 10$, $a = 11.25$, and $b = 11.125$

| $N$ | $a$ | $(b-N)$ | $F$ | $1/F$ |
|---|---|---|---|---|
| 1 | 11.25 ÷ | 10.125 = | 1.111 | 0.9000 $A$ |
| 2 | 11.25 ÷ | 9.125 = | 1.233 | 0.8111 $B$ |
| 3 | 11.25 ÷ | 8.125 = | 1.385 | 0.7222 $C$ |
| 4 | 11.25 ÷ | 7.125 = | 1.579 | 0.6333 $D$ |
| 5 | 11.25 ÷ | 6.125 = | 1.837 | 0.5445 $E$ |
| Center ..... | | | | |
| 6 | 11.25 ÷ | 5.125 = | 2.195 | 0.4555 $E_1$ |
| 7 | 11.25 ÷ | 4.125 = | 2.727 | 0.3667 $D_1$ |
| 8 | 11.25 ÷ | 3.125 = | 3.6 | 0.2778 $C_1$ |
| 9 | 11.25 ÷ | 2.125 = | 5.29 | 0.1889 $B_1$ |
| 10 | 11.25 ÷ | 1.125 = | 10.0 | 0.1000 $A_1$ |
| $(A + A_1)$, $(B + B_1)$ etc., each | | | = | 100 per cent. |

So long as annual totals only are plotted against the frequencies as above obtained, no confusion can result and the frequency curve will be truly representative of the chance. When however magnitudes for fractional intervals of the year are considered, the risk which we are trying to determine seems to be often lost sight of.

Suppose we have gathered one hour maximum rainfall rates over a period of 10 years and for the extreme wet year we have 20 observations and for the extreme dry year 10 observations with a total of 150 observations, all observations less than some arbitrary rate having been discarded or not observed.

Shall we now, as often in effect is done, select the 10 highest and discard the balance of the 150 observations as having no bearing on our chance problem? It is obvious that this will result in no representation for some of the years and excessive representation for others.

The fallacy of this may perhaps be best realized if we consider each of these years as a horse race, making ten races in all with a total of 150 entries varying from 10 in the smallest field to 20 in the largest. If bets were placed on the magnitude or speed of the various races, the fact that the also-rans in one race might have exceeded the speed of the winner in another would have no bearing on the chances taken in the bets.

Similarly, if I were to lay you odds that a given 1-hour rate of rain will not occur in a given year, the chances I would be taking will not be governed by the fact that in one certain year the given rate may be exceeded several times but by the number of years in which the rate is exceeded.

In viewing events in the light of approach to a maximum we automatically must interest ourselves in winners only and our chances are determined by the winners or maximums for the various classifications. It happens that the only sane basis of classification for rainfall and runoff events is the year or one complete cycle of meteorological causes.

It must follow then that the 150 1-hour rates on hand must be so sorted that we retain the maximum only for each of the 10 years discarding the rest as having no bearing on the chance. The discards will no doubt contain a fair number of magnitudes that exceed many of those retained but if any of these discards were retained the result will not index the chance.

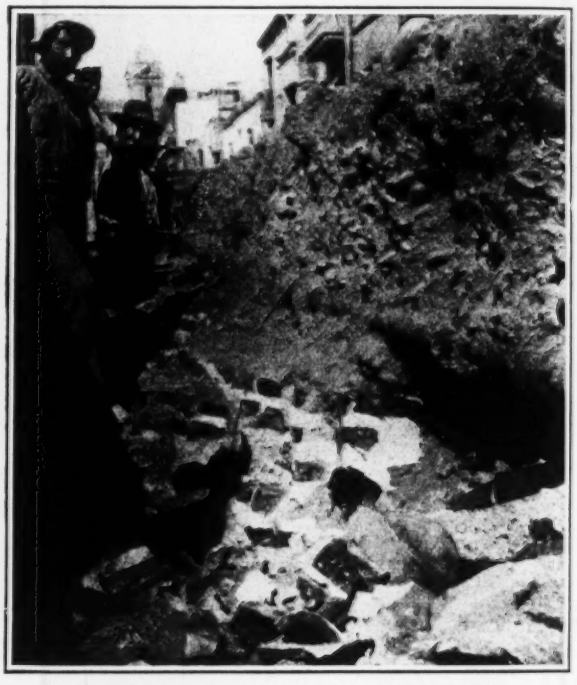
The use of the 10 actual highest, as has often in effect been done, can result only in a false view of the chance; and the magnitudes determined for given odds will be in excess of the true magnitudes for such odds for all frequencies excepting only the frequency for the greatest magnitude in the series.

If we are to use probabilities as a guide to determine the chances we are running, let us consider this mystery of time and class at least as rationally as a bookmaker.

Montevideo, Minn. S. L. MOYER,
May 13, 1925. Consulting Engineer.

## Vitrified Pipe Under Pressure

Sir—In looking through your issue of Feb. 19, 1925, I saw a letter on p. 330 from P. T. Hyland concerning some vitrified water pipe. The Foundation Co. has been putting in a new water system in Lima, Peru, and in digging up some



CLAY PIPE LAID IN 16TH CENTURY IN PERU

of the streets we ran into an old system that was put into service in the latter part of the sixteenth century. The pipes were of glazed, vitrified clay. There were two of them, one about six inches in diameter and the other about four. They were encased in bricks laid in lime mortar.

We found it in various places with a difference in elevation of about 15 meters, but know that it went as far as Pizarro's palace, which would be some 10 meters more. So that there must have been a total head of something like 75 ft. However, there would have been nothing like the pressure indicated by that head, since the water was delivered to fountains, or hydrants that were allowed to run constantly.

The accompanying illustration shows a section uncovered in one of the streets. J. L. MCCLINTON.

Cuzco, Peru, S. A.,
April 29, 1925.

# News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

## General Contractors Hold Spring Meeting

**Four-Days' Session of Executive Board Inaugurates Campaign Against Day-Labor Construction**

About fifty members of the Associated General Contractors took part in the spring meeting of the Executive Board, held May 19-22, at Washington. Besides the regular order of standing committee reports and association business there was a special session on day-labor construction, another devoted to the conference on contract bonding and special discussion of accident prevention in which steps were taken to extend the practice of the Detroit chapter to other localities and so create a source of income for association work. Under the plan of the Detroit chapter half the savings from premiums now paid to insurance companies goes to the association. Several chapters indicated a willingness to give the plan a trial.

A full day was given to the discussion of construction by force account. A 45-page report by the staff engineers opened the proceedings with a statement of the trend toward day-labor work giving various examples. Tabulations were offered showing extravagant costs on certain specified jobs. Especial criticism was directed toward the Corps of Engineers of the Army. It was contended that the corps could be held the leading offender in the encouragement of day labor because its reputation and high standing gave its practices especial authority.

Charges were made that the Corps now performs some 75 per cent of the construction work under its direction by day labor, had accumulated over $60,000,000 of construction plant and not content with doing its own work by day labor had in instances competed with contractors for private work. It was claimed that the estimates of cost made by the Corps are unreliable, inaccurate and not complete; that the Corps freely violates the plans and specifications, that the Corps generally takes more time to complete the work by day labor than is specified in tenders for bids and that the ultimate cost by day labor is always greater than contract prices. These charges, freely and not too accurately reported in the Washington daily newspapers, brought forth denials and recriminations from leading officers of the Corps.

With the presentation of charges and examples attention was turned to ways and means of combatting the preference of the Engineer Corps for day labor construction. Members and chapters were urged to carry the fight back home and bring every possible political and business influence to bear in driving day labor out of government construction except for the legitimate purpose of maintenance and in emergency operations.

## Engineering Fifty Year Ago

**From *Engineering News*, May, 1875**

### Streets

By B. H. Cunningham

MACADAM thought that the cubes should weigh not more than 6 oz., or, what is about the same thing, should pass through a 2½-in. ring, and this size has been generally adopted, so we may assume that it is about right. It would be possible, however, to consolidate larger metal if the roads were rolled, and this would make them stronger, as well as save labor. Blinding ought certainly to be applied. There is a little confusion about this term, some writers using the word "binding", apparently from an idea that it better expresses what is meant. "Blinding" is however precisely the same word as "blending." To blend originally meant to mix, and "bind" has acquired its ordinary meaning from the fact "that mixture causes obscurity." "Blinding" therefore, when it denotes the sand or fine gravel put on a road, is used in its original sense, and implies that the material so named should be thoroughly mixed amongst the stone, so as to fill up the empty spaces. This is exactly what it is meant to do.

* * * *

Macadam roadways have many good qualities, but there is one most serious objection to their use in towns. The metal wears so rapidly that they are always covered with mud or dust, and can only be maintained in good order by constant and expensive repairs.

Obviously this system can be modified in various ways, by adding cement to the metal. Thus, either the foundation or the top metal, or both, can be made into concrete.

Mr. Proudfoot, the engineer to the City Road Trust, by means of the steam roller and a machine for mixing the cement,—also by careful attention to the selection of metal and workmanship, has succeeded in producing much better roads of this kind. I fear, however, that they are deficient in elasticity, and would therefore wear rapidly if exposed to heavy traffic. The long time which the cement takes—generally about a month—during which the street must be shut up, is also a serious disadvantage. But these objections may not be important in many cases.

On the whole, we may conclude that macadam and macadam concrete roadways, although they may answer well in secondary streets, should not be laid in main thoroughfares. We may also conclude that neither this system of road making nor any development of it, is likely to produce the street of the future.

## Great Northern Ry. Starts Bus Operation

**Organizes Companies to Supplement Its Train Service and Keep Men Employed**

Articles of incorporation were filed at St. Paul, Minn., May 21 for two bus companies, the Great Northern Transit Co. and the Minnesota Transportation Co. with $1,000,000 capital each. The incorporators are: Louis W. Hill, chairman; Ralph Budd, president; W. P. Kenney, vice president; D. J. Kerr, assistant to the vice-president of operation—all of the Great Northern Railway Co. General offices will be in the general offices of the Great Northern Railway Co. of St. Paul.

It is the intention of these companies to operate bus service supplementary to their train service and so correlated as to best accommodate public travel. It will also stabilize the employment in railway service, which during the past few years has suffered greatly. Train and enginemen, possessors of seniority rights of long standing who had every reason to feel secure in their employment have been thrown out of service on account of commercial vehicles operating on public highways.

In commenting upon this movement, Great Northern officials pointed out that their railroad company has been engaged in the transportation of freight and passengers for more than sixty years; that their lines were constructed through uninhabited territory and that the development of this territory was exclusively produced and occasioned by the construction of this line; that the continued operation by the Great Northern Railway Co. of train service and freight service is necessary and indispensable, therefore, it is necessary and essential that revenues derived from the transportation business in the Great Northern territory be paid to and received by the Great Northern Railway Co. The Great Northern Railway Co. is of the opinion that the public interest, both agricultural and urban, require that all the revenue derived from transportation of both persons and property be paid to the essential carriers, that the public may have adequate and proper transportation facilities at reasonable rates.

## Tall Buildings for Toronto

The Dominion Building Corporation is reported to have decided to proceed with the erection of a 26 story structure in Toronto, Ontario, Canada, at the corner of King and Young St., to be known as the Canadian National Building. It will be 295 ft. high and will cost $2,500,000. The principal tenant will be the Canadian National Railways. It is believed this will be the highest office building in the British Empire.

## Random Lines

### *Mathematics Gone Wild*

The accompanying formula is not the trace of the orbit of a new comet, nor the algebraic analysis of some special kind of radio emanation. It might be some of Mr. Einstein's latest ebullitions, because it looks as though it came under the familiar Einstein category of not being understandable by more than twelve men in the world. But it is none of these things. It is the "length-of-haul law" for all classes of traffic in New York City as presented in the report of the Regional Plan of New York on highway traffic in New York. It was arrived at by watching the little taxicabs run to and

$$\text{Log}\frac{\left(\frac{X_o}{H}\right)^{\sin\theta}}{\left(\frac{Y_o}{K}\right)^{\cos\theta}} = \left[\log^2\left(\frac{K^{\sin\theta}H^{\cos\theta}}{Y_o^{\sin\theta}X_o^{\cos\theta}}\right)^m - b^2\right]^{1/4} + \left[d^2 + \frac{cd}{c-a} - \log^2\left(\frac{K^{\sin\theta}H^{\cos\theta}}{Y_o^{\sin\theta}X_o^{\cos\theta}}\right)^{\frac{d}{c-a}}\right]^{1/4}$$

fro up and down the streets of Manhattan and checking the errant truck as it flitted back and forth along West St. In the words of Mr. Rube Goldberg, "Now you've got it, what are you going to do with it?"

* * *

### *A Shotgun Engineer*

As a witness against the Pacific Gas & Electric Co. in a suit involving riparian rights in northern California, a county surveyor testified that he had measured the width of a certain stream and found it to be more than 150 ft. wide. Under cross-examination he admitted that the measurement had not been with a steel tape but "by other means." After persistent questioning he finally explained that his shotgun could be depended upon to kill a duck at a distance of 50 yards and he knew that the stream exceeded that width because he had repeatedly shot at ducks on the far side but had never killed one from across the river.

* * *

### *Mutually Exclusive, Too.*

Sir—The list of kinds of engineers may now be closed! There are but two classes of men in industry—Profiteers and Engineers.

Scott Ncaring, sometime parlor pink petagog, says so.

On p. 31 of his "Oil and the Germs of War" read "The Profiteer (owner) challenges the Engineer (worker)."

And that's that. C. M. C.

* * *

### *Flexible Steel!*

Philadelphia newspaper reporters introduced the public to a new grade of flexible steel last week, when, in reporting on an address by one of the bridge engineers they stated that "The towers which will hold the great span across the Delaware River will give 20 ft." Deflection of 20 ft. in the tower height of 350 ft. represents only about 6 per cent deflection! The reporter was modest. The actual deflection of the towers will be about 20 in.

## 2 Million Gallon Elevated Tank to Be Built

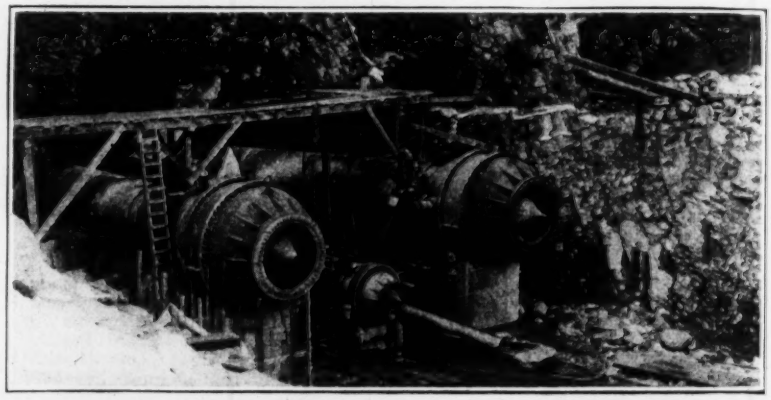
A contract has been let by Charleston, S. C., for construction of the largest elevated tank with curved bottom ever built to the Chicago Bridge & Iron Works. The tank will have a capacity of 2,000,000 gallons. The largest structure of this type heretofore built is a hemispherical-bottom steel tank of 1,400,000 gallons capacity.

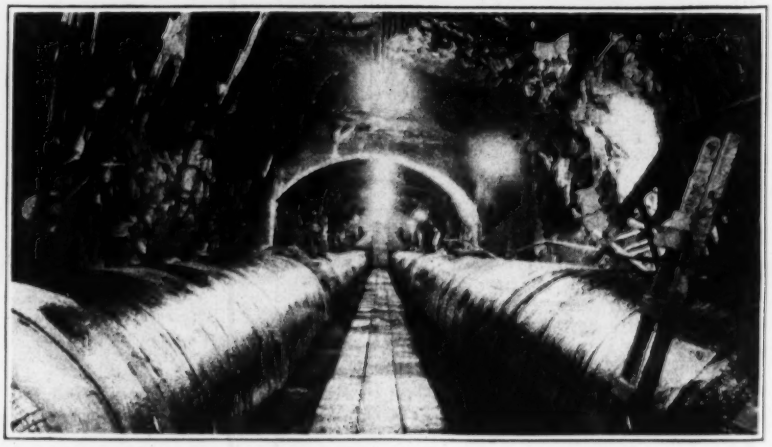
The new tank which weighs approximately 600 tons, is 80 ft. in diameter. The vertical shell of the tank is 35 ft. high, and the ellipsoidal bottom is 26 ft. 8 in. deep. The bottom of the tank is elevated 53 ft. 6 in. above the ground by 24 columns. The tank will be fabricated at Greenville, Pa.

## Two Railroads Propose Big Utah Developments

To develop the rich mineral resources and agricultural possibilities of the Uintah Basin district in Utah, the Denver & Rio Grande Western R.R. has applied for permission from the Interstate Commerce Commission to build a 130-mile branch northeast from Soldier Summer to Vernal. A location for a line with 2 per cent maximum grades has been made and the cost is estimated at about $7,000,000. A more ambitious project is that of the Salt Lake & Denver R.R., which has applied for permission to build a line from Provo, Utah, eastward about 250 miles to the present terminal of the Denver & Salt Lake R.R. at Craig, Colo. This line would complete the short route between Denver and Salt Lake City which was the basis of Mr. Moffat's original project for what is now the Denver & Salt Lake R.R., halted midway, at Craig, by financial reverses. The new project for the Utah end of this route is promoted by ex-governor Bamberger of Utah.

## Work on Tieton Dam Approaches Completion





Work on the Tieton dam, a part of the Yakima reclamation project, is practically completed. It is now expected that the ceremony marking the completion will be held on July 15, when the Secretary of the Interior, the Secretary of Agriculture, and the commissioners of reclamation and of Indian affairs will be present. The two pictures of the project, taken some weeks ago, show, above, two needle valves at the end of the 6-ft. pipe line and below the interior of the tunnel looking toward the emergency gatehouse. The housing of the needle valves was the last structure to be erected.

## Delegates to International Ry. Congress Appointed

The following named men have been delegated by the United States Government to attend the International Railway Congress to be held in London, England, June 22 to July 6, 1925:

Henry C. Hall, Interstate Commerce Commission; Col. Edward A. Simmons, president, Simmons-Boardman Publishing Co., publishers of *Railway Age*, New York City; David Francis Crawford, president, Locomotive Stoker Co., Pittsburgh, Penn.; A. L. Humphrey, president, Westinghouse Air Brake Co., Pittsburgh, Penn.; Walter F. Schleiter, vice-president of Dilworth, Porter & Co., Pittsburgh, Penn.; Harold A. Smith, president of the *Railway Review*, Chicago, Ill.; Frank W. Noxon, secretary of the Railway Business Association, Philadelphia, Penn.; Charles H. Muchnic, vice-president, American Locomotive Sales Corp., New York City; Thomas C. McBride, Manager, Locomotive Heater Department of the Worthington Pump & Machinery Corp.

The United States became an adhering member of the International Railway Congress in 1905, after Congress had made an appropriation for the annual quota pursuant to a recommendation made by Mr. Hay, Secretary of State. The association periodically calls international railroad conferences. The above is a list of the delegates of the United States Government and does not include the delegates which the railways may send to the Congress.

## New Rail and Water Facilities Planned for Detroit

Plans for the new water and rail terminal facilities as given out recently by the Detroit Railway & Harbor Terminal Co. include the construction of docks, railroad sidings, a power plant and an eight-story terminal warehouse on a 12-acre site fronting on the Detroit River and Jefferson Ave. West. The total invested in land and plant will ultimately reach $8,000,000. In addition to the terminal site, the company owns tracks and right-of-way from the river to the main line of the Pennsylvania, Pere Marquette and Wabash Railroads and Union Belt Line.

The first warehouse unit will have 700,000 sq.ft. of general warehouse space and 200,000 sq.ft. of cold storage space. The building will be of reinforced concrete, 200 ft. wide by 600 ft. long, and equipped with modern freight-handling conveniences. Contract for the construction of the first unit has been let to the Parklap Construction Co. of New York.

## Montreal Bridge Contract Let

The contract for the substructure of the South Shore bridge, between St. Helen's Island, Montreal, and the south shore, including 18 piers and 1 abutment, has been awarded by the Harbor Commissioners to Quinlan Robertson & Janin, Limited, Montreal. Their tender of $936,749 was the lowest. This contract is only for the southern half of the bridge. The date of completion is given as November 15, 1926.

## Recover Thirteen Bodies from Sunken "Norman"

Bodies of seven engineers are among the thirteen recovered up to May 21 from the wreck of the steamship *Norman* which sank May 8 in the Mississippi River below Memphis. The total list includes Major Charles H. Miller, Little Rock, Ark.; Charles E. Shearer, Memphis; Ralph Bosard and son, Memphis; Prof. Walter Kirkpatrick, University, Miss.; S. Waters Fox, Paducah, Ky.; W. O. Walker, Fulton, Ky.; Mrs. Lydia Hidinger and Mrs. Lonnie Caldwell, Memphis; Wm. Hannum, Memphis, and three members of the crew. The information comes from Harry B. Hunter, one of the survivors from the office of Mr. Shearer.

## New Sewerage District Created in Massachusetts

The South Essex Sewerage District was created by the Massachusetts Legislature just before its recent adjournment. It includes the cities of Salem, Beverly and Peabody, the town of Danvers, the Danvers State Hospital and its colony for the treatment of tuberculosis, the County Tuberculosis Hospital at Middleton, a camp for tubercular prisoners, and the Essex County Agricultural School. The general plans for the work to be done under this act were made by the State Department of Health under the direction of X. H. Goodenough, chief engineer, and reported to the Legislature of 1924 which created a special committee to recommend a plan for allocating construction and maintenance costs.

The first cost will be based one-third upon the assessed valuation of the cities, towns and institutions served, and two-thirds in proportion to the flow of sewage from the various towns and institutions in the years 1926 and 1927. The cost of maintenance and operation is apportioned each year according to the valuation and the flow of sewage in the previous year, on the one-third and two-thirds basis already mentioned. The first-cost allocation plan is modified in that certain sections of the main sewers and their maintenance are to be paid for by specific institutions and communities, thus: The hospitals at the upper end of the trunk sewer pay the total cost of the trunk sewer down to a point in Danvers where the Danvers sewerage system would naturally begin. From this point onward the cost of several sections of the work is separately apportioned to the municipalities respectively involved in accordance with the plan already stated. After the main sewers of all the towns and municipalities are joined up the cost of the outfall for the remainder of the way is apportioned to all.

The present Salem and Peabody trunk sewer, including the outfall sewer, and also part of the Beverly main sewer will be utilized in the new joint system. The ocean outfall now in existence will be extended 2,000 ft. beyond the present outlet at Great Haste in order to reach a point where the water will be 30 ft. in depth at low tide. The present outlet is only 9 ft. below the surface of the sea at low tide.

## Dean McClenahan Goes to Franklin Institute as Secretary

Dean McClenahan of Princeton University has resigned from the Princeton faculty to become secretary of Franklin Institute at Philadelphia. Dean McClenahan has been dean of the college at Princeton for the past thirteen years and had taught physics at Princeton for twenty-seven years. As secretary of Franklin Institute he becomes executive head of that institution and will direct all its work in research and for the promotion of science and mechanics. Franklin Institute recently received a bequest of $2,000,000, to be known as the Bartel Foundation, for carrying on research work in the sciences.

Dean McClenahan is a graduate of Princeton University of the class of 1895. He is chairman of the College Entrance Examination Board and a former president of the Association of Colleges and Preparatory Schools of the Middle States and Maryland. In 1914 he was sent by Princeton alumni to investigate conditions in Belgium, and on his return he lectured throughout the country to raise money for Belgium relief work. In 1919 he was created officer de l'ordre de la Couronne by King Albert for his services.

## Long Beach, Calif., Harbor Work to Be Extended

Continuation of the harbor work at Long Beach, Calif., begun last year, to include bulkheads and breakwaters in the outer harbor is planned by the Long Beach Harbor Department. The dredging of the inner harbor which was started in August, 1924, is about 70 per cent complete, over 4,000,000 cu.yd of material having been removed from the channels and used for reclaiming adjacent areas. The new work which is now proposed includes the construction of two moles having a total length of 4,200 ft., 3,000 ft. of bulkheads and a 7,000-ft. breakwater. The moles and bulkheads are to be of rubble mound construction in which the distribution of the various classes of stone is so arranged as to provide sand tightness for the retention of backfill on the landward side and protection against wave wash on the harbor side. It is expected that this work will be advertised for bids in the near future. It is to be done by the Long Beach Harbor Department under the supervision of Lt.-Col. E. N. Johnston, Corps of Engineers (retired), as consulting engineer.

## Boston & Maine R.R. to Try Store-Door Delivery

The Boston & Maine Railroad Co. plans to inaugurate a system of store-door delivery of freight at Boston, Lowell and at Lawrence Mass., about June 1. The company is also considering the use of motor trucks for the transportation of less-than-carload shipments between Boston and Lowell and Boston and Lawrence. In this work it is proposed to enter into contracts with existing trucking companies wherever practicable in order to avoid wasteful competition.

## George Smart, of "Iron Age," Dies

George Smart, managing news editor of *Iron Age*, died May 16 of erysipelas at his home in Forest Hills, Long Island. Mr. Smart had been chairman of the Editorial Conference of New York Business Papers and a member of the executive committee of the National Conference of Business Paper Editors. He was born in Chillicothe, Ohio, in 1863 and was educated at Ohio State University. On the Cleveland *Plain Dealer* he worked for eight years and then served a year on the Cincinnati *Enquirer*. Then he went to Columbus and helped establish the Columbus *Citizen*, of which he was editor for three years. There followed editorial work for a long period on the *Iron Trade Review;* leaving that in 1917 Mr. Smart became news editor of *Iron Age*.

## Contract Bonding Conference Meets Again

Representatives of a number of national engineering societies interested in contract surety bonds met in Washington on May 22 in continuance of the joint conference on that subject which met first in Washington on Feb. 16. There were present representatives of the American Institute of Consulting Engineers, American Association of State Highway Officials, American Society of Civil Engineers, American Institute of Architects, Associated General Contractors of America, American Society of Mechanical Engineers, American Society for Municipal Improvement, and the Highway Industries Exhibitors Association. In addition there were representatives of the government departments and a number of engineers and officers of surety companies. The meeting was presided over by R. C. Marshall, of the Associated General Contractors.

At the outset correspondence between the chairman and the secretary of the Surety Association of America was read. It appeared from this correspondence that the latter association has been apprehensive of some action on the part of the conference not altogether favorable to the sureties and therefore has not been disposed to join with the present conference but rather suggests the formation of a new conference in which it would participate. However, it appeared from discussion that there is more than a fair chance that the Surety Association will reconsider this stand and will join in the present conference.

The major action of the conference was to accept the report of the Committee on Uniform Questionnaires, of which S. M. Williams is chairman, and to adopt with some amendments the forms of questionnaire prepared by that committee. These standard forms are recommended for the use of public officials, surety companies and banks. They consist of the contractor's financial statement, the contractor's plant and equipment questionnaire and the contractor's experience questionnaire, giving full information from which public officials, primarily, but banks or sureties, secondarily, may determine a bidder's responsibility to undertake work.

There was some discussion as to whether public officials should be requested to demand the filling of these forms from all bidders prior to the bid or only from the lowest one to three bidders after the bid. As finally adopted this was left to the discretion of the officials.

Action of the conference consisted in the adoption of these questionnaires and the recommendation to the representatives of each society to request approval and publication of the questionnaires by the respective societies. Further action consisted in the establishment of the conference as a continuing body, to which the sureties are formally asked to send representatives.

## Lancaster Appointed to State Transit Commission

William C. Lancaster has been appointed chief engineer of the New York State Transit Commission to succeed the late John H. Madden. Mr. Lancaster, who is a native of New York City, was educated at Richmond, Va., and graduated from the University of Virginia with degrees of mechanical and civil engineer in 1903. After leaving the university he went to the testing department of the General Electric Co. at Schenectady for apprenticeship in electric traction. Following this he worked on the crosstown tunnels of the Pennsylvania R.R. in New York City and later went to Havana, Cuba, for the construction of the sewerage system there, including considerable tunnel work. In 1912 Mr. Lancaster went to Montreal, Canada, as electrical engineer for the Canadian Northern Ry. (now the Canadian National Ry.) in charge of mechanical work on the Mount Royal tunnels and the design of equipment for the electrified zone. During the war he went to France as a company commander with the 45th Engineers, later being promoted to the rank of major and placed in charge of the mechanical unloading equipment at the army docks at Bassens and LaPallice. From 1919 to 1922 Mr. Lancaster was consulting engineer for a number of firms at New York including the New York Harbor Dry Dock Co. and the New York Trap Rock Corp. In 1922 he became electrical engineer, tunnel division, New York City Board of Estimate and Apportionment, on the Narrows tunnel, which position he held until his appointment as chief engineer of the Transit Commission.

## World's Largest Power Station to Be Built in New York

The New York Edison Co. has announced that the new power station which it will build on the East River at the foot of 14th St. in New York City will ultimately contain nine turbo-generators of 80,000 hp. capacity each, or a total of 720,000 hp. The estimated cost is $50,000,000 or about the same as the new power plant at Muscle Shoals which will have an installed capacity of 612,000 hp. The contract for the first two generators has been let to the General Electric Co.

## Court Throws Out Suit Over Seattle Bridge Design

In the suit of the Strauss Bascule Bridge Co. of Chicago against the city of Seattle, Wash., Federal Judge Neterer recently filed a decision in the United States Court, sustaining a demurer to the suit for $119,392.14. Judge Neterer held that there were insufficient facts to maintain a cause of action, that the bridge company failed to file a claim as required by charter against the city, and that any damages for slander and libel must be brought against the city engineer and associates, and not against the municipal corporation.

This is one of several suits growing out of the use of the bascule type of bridge by the city of Seattle. An injunction in the suit affecting the Montlake bridge across the Lake Washington ship canal at the University was reported in *Engineering News-Record*, May 7, p. 782.

Of the sum sought, $100,000 was asked for damages caused by slanderous and libelous statements made by the city engineer and associates relative to the Strauss Company's type of bridge. The remaining sum, $19,392.14, represents money due because of purported failure of the city to fulfill contractual obligations in connection with the plans for the West Spokane St. bridge. A committee of engineers, it was claimed in the complaint, stated that the city's plan for the superstructure of the bridge was better and would cost less than the Strauss Company's plan. These statements the company contends are untrue and tend to damage the company.

## Los Angeles to Vote on Water Bonds June 2

The proposal to issue $10,000,000 in bonds for the use of the Los Angeles water bureau is to be put before the voters of that city on June 2. Of this sum it is proposed to use $2,000,000 for work on the project for bringing Colorado River water to the city. The remaining $8,000,000 is for extension of the present water system, divided as follows: for the purchase of lands in Owens River Valley and for the development of water resources there, $4,500,000; for extension of water mains and lines in the city, $2,700,000; for completion of St. Francis dam in San Francisquito canyon, $800,000.

## Indianapolis Sewage-Works Opened Officially May 23

The new sewage-works of Indianapolis, Ind., were officially opened on May 23 with Dr. Karl Imhoff, of Essen, Germany, as a guest of honor. The plant includes fine screens of the revolving drum type, rapid settling tanks with thickeners, and aerating and settling tanks, the latter comprising the activated-sludge process for use during low-stream-flow periods. (See *Engineering News-Record*, March 23, 1922, p. 484, and Aug. 16, 1923, p. 258.) The works were built under the direction of the Indianapolis Sanitary Commission, with Charles H. Hurd as consulting engineer.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Union College, Schenectady, N. Y., June 17-20, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Salt Lake City, July 8-10, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-29, 1925.

**The New York Section, American Society of Civil Engineers,** at its annual meeting held May 20, elected the following officers for the year 1925: President, George J. Ray, chief engineer, Delaware, Lackawanna & Western Ry.; vice-president, John P. Hogan, consulting engineer, New York City; and treasurer, Charles A. Mead, chief engineer, Division of Bridges and Grade Crossings, New Jersey Board of Public Utility Commissioners. Harold M. Lewis is secretary of the section.

**The New England Water Works Association** has invited the Boston Society of Civil Engineers to join in an excursion to Providence, R. I., to see the work now under way for additional water supply of that city. The probable date for the excursion is June 23.

**The Boston Society of Civil Engineers, Sanitary Section,** has planned as its June meeting a visit on June 6 to the Lawrence, Mass., Experiment Station of the Massachusetts Department of Health.

**The American Society of Agricultural Engineers** will hold its annual meeting at Madison, Wis., June 22-25, 1925. The program includes sessions devoted to farm power and machinery, reclamation, farm structures, co-operative relations with colleges, and demonstrations of marsh drainage work. Raymond Olney, Mount Clemens, Mich., is secretary of the society.

# Personal Notes

REAR ADMIRAL SAMUEL MCGOWAN, retired, former paymaster general of the Navy who served in that capacity during the World War, has been appointed chief highway commissioner of South Carolina. In that capacity he will have, according to the act creating the office of chief highway commissioner, the authority to appoint employees heretofore vested in the state highway engineer and the secretary of the state highway commission. Mr. McGowan is a graduate of the University of South Carolina.

COL. FREDERICK MEARS has resigned his position as chief engineer of the St. Paul Union Depot Co., to become assistant chief engineer of the Great Northern Ry., with headquarters at Seattle, Wash. Previous to his connection with the St. Paul union station work he was for several years chairman and chief engineer of the Alaska Engineering Commission, in charge of the construction of the Alaska Railroad. After serving in France during the War he returned to his Alaska position, but resigned when the railroad was completed.

J. R. W. DAVIS, engineer of maintenance-of-way, Great Northern Ry., since 1908, has been appointed chief engineer, succeeding A. H. HOGELAND, who is appointed consulting engineer. O. S. BOWEN, assistant chief engineer at Seattle, and H. F. HAMILTON, district engineer at St. Paul, have been appointed assistants to the chief engineer, both with offices at St. Paul.

A. C. TONER, of the Portland Cement Association, who has been district engineer at Pittsburgh since 1916, is now made assistant general manager of the association to supervise work in western Pennsylvania, Ohio and West Virginia. The work in Ohio has been under the direction of the Pittsburgh office; a new district office is now opened at Columbus, Ohio, the new district engineer in charge of this office being R. L. BROWN, who since 1918 has been a field engineer connected with the Indianapolis office of the association. In the Pittsburgh district office, R. A. WAHL succeeds Mr. Toner.

RICHARD BIEHL, city manager at Westerville, Ohio, for the past three years and prior to that chief engineer for the Firestone Tire & Rubber Co., has resigned his position at Westerville to become city manager at Two River, Wis.

L. G. WHITNEY, Detroit, Mich., has been chosen city manager at Westerville, Ohio, succeeding Richard Biehl, resigned. Mr. Whitney is a graduate of the University of Michigan and for several years has been employed by the Government Research Bureau at Detroit.

C. P. GROSS has recently been appointed city engineer for Wisconsin Rapids, Wis.

GROVER H. WILSEY, principal assistant engineer of the St. Paul Union Depot Co., has been appointed chief engineer, succeeding COL. FREDERICK MEARS, who has resigned. Mr. Wilsey, after being a draftsman in the bridge department of the Chicago, Milwaukee & St. Paul Ry. and then of the Chicago & Northwestern Ry., 1908-1910, was structural designer with D. H. Burnham & Co., architects, Chicago, 1911 to 1914, and then went to the St. Paul Union Depot Co. in 1915, becoming structural engineer in 1917 and principal assistant engineer in 1923.

# Obituary

JOHN EDWARD MCGRATH, a retired officer of the U. S. Coast and Geodetic Survey, died in Washington, D. C., on May 14. Mr. McGrath was in his 69th year at the time of his death. He was a graduate of the School of Mines and Metallurgy of the University of Missouri with the degree of civil engineer in the class of 1876 and entered the Coast and Geodetic Survey in 1878, advancing through various ranks to the position of hydrographic and geodetic engineer. He retired from active service in November, 1921. From 1889 until 1895 Mr. McGrath was employed on the Alaska boundary work. It was during this time that he discovered and determined the height of Mount Logan.

COL. WILLIAM H. HEUER, U. S. A., retired, who was widely known for his enineering surveys throughout the United States and especially on the Pacific Coast, died April 28 at his home in San Francisco, Calif., aged 82 years. Colonel Heuer was born in St. Louis, Mo., and graduated at West Point in 1865. The following five years he spent in river and harbor work in California and Oregon, then one year with the engineer troops. From 1872 to 1876 he was in local charge at Hallett's Point (Hell Gate), New York City. In 1876 he measured the Central Pacific R.R. from Sacramento, Calif., to Battle Mountain, Nev. Succeeding service until retirement in 1907 was devoted to lighthouse construction and to river and harbor work, variously on the Delaware at Philadelphia, the Mississippi at New Orleans, at San Francisco, on the Florida reefs. Many official reports to the government were his work. He was one of the early investigators of location for an interoceanic canal, Nicaragua, Darien and Panama routes. After retirement from the Corps of Engineers in 1907 he practiced as a consulting engineer; in 1913 he made full engineering study of San Francisco Bay. During the World War he was placed in charge of certain engineering activities on the Pacific Coast and the Hawaiian Islands.

REV. WILLIAM REED EASTMAN, whose death occurred in Washington, D. C., March 25, 1925, was in his early youth an assistant of Capt. Andrew Talcott, chief engineer of the Mexican Ry., Vera Cruz to the city of Mexico. He ran the original line of the so-called Maltrata incline or grade line between Boca Del Monte and Maltrata, where a drop of over 2,000 ft. occurs in 12 miles. Mr. Eastman was born in New York City in 1835. Returning home from Mexico he was ordained a minister, holding for several years pastorates in New England churches. Mr. Eastman served in the Civil War as chaplain of the 72nd N. Y. Volunteers, being a member of the Albany, N. Y., post, G. A. R.

# From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

## Paving Brick Industry Hitting Summer Stride

Increases in the four items of stock, production, shipments and unfilled orders were noted in the paving brick industry for the month of April, according to the monthly statistical report of the National Paving Brick Manufacturers Association.

Production increased from 27,404,000 brick in March to 28,444,000 in April; shipments went from 12,271,000 to 18,738,000; stock from 135,435,000 to 139,223,000; and unfilled orders jumped from 64,091,000 to 68,636,000.

The report is composed of returns from 31 companies representing 71 per cent of the normal monthly capacity of the industry. These companies reported April production at 81 per cent of their monthly capacity.

## Manufacturers Will Exhibit at Bridgeport Exposition

In connection with the exposition known as Progress Week that will be staged in Bridgeport, Conn., May 30-June 6, the 443 local manufacturing plants will contribute a large proportion of the exhibits. The purpose of the exhibition is to show the growth of the city and its institutions during the past 50 years. The profits realized from the exposition are to be devoted to the establishment of an industrial bureau to bring new industries to Bridgeport.

## Displays of A.G.C. Mixer Name Plates

The headquarters office of each branch of the Associated General Contractors is soon to have on display a full set of the standard mixer name plates, together with a list of the equipment manufacturers who have complied with the standardization provisions and are entitled to use these name plates on their mixers.

The purpose of the display is to give the users of this equipment an opportunity to become thoroughly familiar with the type of identification used so that they may know when equipment offered to them for purchase has been manufactured under the standardization provision. The display marks an effort on the part of the contractors to co-operate in the standardization plan so that benefits from it may be gained as soon as possible.

# Business Notes

H. E. NEWBAUER, formerly assistant chief engineer of the Buffalo Foundry & Machine Co., has become associated with the Chemical & Vacuum Machinery Co., Buffalo, as chief engineer.

CATERPILLAR TRACTOR CO. is the name of the new company formed by the consolidation of the Holt Manufacturing Co., Peoria, Ill., and the C. L. Best Tractor Co., San Leandro, California. The new corporation is organized under the laws of California, and its principal business will be that of manufacturing and selling the combined products of the concerns included in the consolidation. The combined sales of the two companies for the year 1924 were $17,500,000. Officials of the company state that trade indications at present point to a largely increased volume of tractor sales in 1925. Officers of the new company are: C. L. Best, chairman of the board; R. C. Force, president; Murray M. Baker and P. E. Holt, vice-presidents; B. C. Heacock, vice-president and secretary, and O. L. Starr, general factory manager.

J. T. TRACTOR CO., Cleveland, announces the following distributor appointments: Hubbard-Floyd Co., for New York City; Ward Equipment Co., Pittsburgh, for eastern Pennsylvania; T. J. Lane Equipment Co., Springfield, for Central Ohio; and Curtis and Burgess, St. Louis, for Missouri.

C. R. CUMMING, formerly secretary of the Industrial Service Co., Lincoln, N. J., has formed the Cumming Co., to handle new and used contractors' equipment and industrial machinery with offices in the Fireman's Building, Newark, N. J.

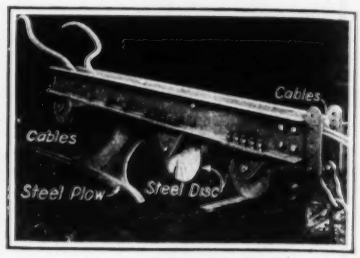
H. W. REDMAN, assistant manager of Pittsburgh office of the Koppel Industrial Car and Equipment Co., has been appointed to succeed R. M. Nelson as manager of the Chicago district.

# Equipment and Materials

## New Device for Laying Cables

A device that will lay armored parkway cables for light, power or fire alarm services in parks, lawns or large estates without disturbing or disfiguring the surface to any appreciable extent has been designed, built and patented by the William E. Kenny Co., engineers and contractors, of New York City. Its construction is shown in the accompanying illustration.

The cable to be installed is first laid upon the ground along the line it is to follow. The surface rollers of the cable layer are adjusted to permit the plow to sink to a depth below the surface that will insure the "cover" that is required on the cable. The cable layer is then placed in position and a tractor is set up at a distance (which is determined by particular conditions) with its pull rope or cable attached to the cable layer. The end of the cable to be installed is passed through the channel in the plow and tightly secured behind it. The engine of the tractor is then started and the plow immediately enters the ground and assumes its proper working position before it travels 10 ft. The cable layer then proceeds on its course, the cable being fed into the plow by a laborer, and as it advances it completes, without further aid, all




of the operations which go to make a finished installation.

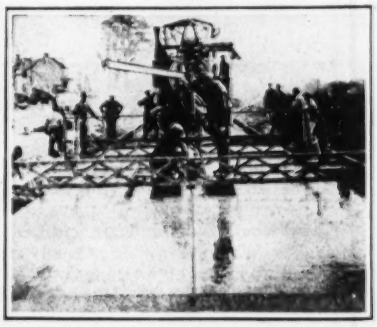
Should rock or other obstructions be encountered the front surface roller is lowered by means of the hand wheel, whereby the front end of the cable layer is elevated causing the plow to ride over the obstruction. Should the obstruction be too great, it then becomes necessary to raise the plow out of the ground. Under favorable conditions a crew of three men with the tractor and cable layer described will install on an average 3,000 lin.ft. of cable in eight hours.

This cable layer has been used with success in connection with the laying of 30 miles of cables for illuminating purposes along the Bronx River Parkway in New York City.

## Mechanical Joint Installer for Concrete Roadways

After concrete roads have been laid for some time unsightly longitudinal and transverse cracks are liable to appear. These defects, it is claimed, are obviated by the use of the Flex-Plane system of construction joints and mechanical joint installer of the Flexible Road Joint Machine Co., Cleveland, Ohio. By the use of the installer machine perfect alignment of transverse and longitudinal construction joints is obtained with considerable saving in time and money; at the same time a straight center joint is made.

The center joint is made by a collapsible steel plate, which is forced into

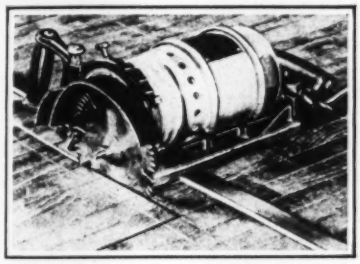


the concrete one-third to one-half through the slab by a combination of shear and vibratory action produced by the installer machine. After the division plates are forced into the surface of the concrete by the machine, which follows immediately back of the finishing machine or screed, they are left in place temporarily and are expanded by an expanding bar which is inserted within the division plate. When the concrete has taken its intial set the expanding bar is removed and the division plate collapsed and withdrawn from the concrete structure and used over and over again. The center joint is then finished by a tool specially designed for the purpose. This produces a weakened or flexible plane through the concrete structure, which predetermines the line of fracture.

Various designs of removable center-joint plates can be used for producing various widths and depths of grooves in the center of the road, which may be filled in later with suitable filler and serve as traffic lines.

## Portable Electric Saw

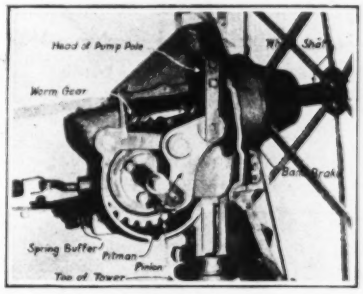
Another application of the electric motor to portable tools is the Casey electric hand saw manufactured by the Router Mfg. Co., Oshkosh, Wis. It consists of a Westinghouse electric motor mounted on a frame similar to a carpenter's plane. A circular saw mounted



on one end of the motor shaft, is rotated by the motor as the frame is pushed over the work. The equipment can be set for any degree of mitre cut and the saws are interchangeable which permits the machine to be used on many kinds of work. Two handles, attached to the frame, are provided to guide the machine. Power is taken from a regular electric light circuit through a flexible cord.

## Steel Windmill for Pumping

In the new "Eclipse" steel windmill for pumping service, brought out by Fairbanks, Morse & Co., Chicago, a worm-gear drive is used, the worm on the wheel shaft gearing with a pinion to which is attached the pitman operating the pump rod or pole. This mechanism, designed to give a slow up stroke (during 67 per cent of the revolution) and a quick down stroke for the empty return, operates in an oil bath, the reservoir of which should need filling only about once a year. A gear reduction of 3⅜ to 1 is employed, the pump making one complete stroke for each 3⅜ revolutions of the wheel. This wheel is so hung that the pressure of the wind upon it is utilized in governing the speed by varying the angle of the wheel to the direction of the wind. When the velocity of the wind exceeds 15 m.p.h. the governing action begins and when the velocity

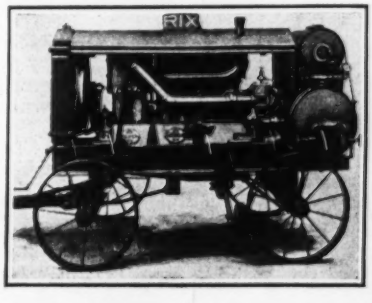



reaches 25 m.p.h. the wheel will be "out of gear" or stationary, due to its angle and to the action of a band brake on the shaft. This brake also comes into action automatically when the wheel is pulled out of the wind in order to stop the pump; the brake increases its grip with the velocity of the wind, so that the wheel does not revolve idly and extra wear on the bearings is thus avoided. A steel spider on the wheel shaft carries the curved steel vanes or sails. With 8- and 10-ft. wheels the pump stroke is 6 and 7½ in. respectively and with a wind velocity of 15 m.p.h. the number of strokes per minute will be 30 and 24 respectively. A galvanized tower 50 ft. to 80 ft. high carries the windmill and has guides for the pump pole at 10 ft. intervals.

## Portable Air Compressor

A light, portable air compressor unit has just been designed and placed on the market by the Rix Compressed Air & Drill Co., San Francisco. The unit, known as the Rix-Six, is self-contained and mounted upon a steel truck equipped with solid rubber-tired wheels, when desired, and designed to be moved as a trailer.

The engine and compressor form a single unit which is bolted directly to the channel iron of the frame of the truck. The weight of the complete unit is about 2,000 lb. and its overall length about 7 ft. The engine is of the four-cylinder type, cylinders 4¾ in. x 6 in., rating 28 hp. at 800 r.p.m. The magneto of the Splitdorf type and the 1-in. centrifugal pump are driven by a shaft and cut gears from the crankshaft. A Stromberg carburetor is placed close to the exhaust manifold. The compressor displacement is 118 cu.ft. of free air per minute and net

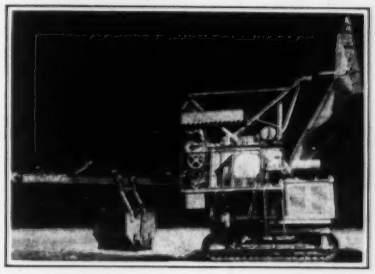



air delivery is approximately 100 cu.ft of free air per minute, suitable for the operation of three paving breakers or two, light hand-held drills. Its light weight renders the compressor particularly convenient for moving over rough ground.

## New Size Paver

The Foote Co., Nunda, N. Y., believing that contractors prefer a 6-bag to a 5-bag mixer, recently announced a new model, called the 26-E. All parts of this new paver are built to handle a 6-bag batch at 1 : 2 : 3½ which produces 25.2 cu.ft. of concrete per batch. The drum has a 27-cu.ft. water level capacity on level grade.

Several improvements have been made, dictated, for the most part, by the stronger working parts required. The wearing rings at the charging opening are flanged inward to deflect material toward the center of the drum and prevent slopping. The tread shoes of the traction have been improved by increasing the size of the tread pin from ¾ in. to 1½ in. in diameter so as to prevent bending or breaking of the pins and stretching of the tread. The location of the hoist has been changed so that it is more easily accessible. The hoist bearings are mounted between the channels instead of on high bearings on top of the I-beams, thus increasing the rigidity of the frame. The



loading skip is centered on the machine so that a standard 92-in. loading skip will operate in an 8-ft. road between forms.

The drum roller shafts have been increased in size from 2¼ in. to 3 in., and alignment is secured by mounting both the front rollers on the same shaft; both rear rollers are mounted in the same manner, instead of using separate shafts for each roller. One of the drum driving gears is made adjustable to insure perfect alignment between the two drum mixer driving gears.

Special attention has been given to making all parts of the machine more easily accessible for adjustment, lubricating and cleaning. The power unit is a Hercules Model L gasoline engine.

## Copper-Steel Transmission Pole

The Truscon Steel Co., Youngstown, Ohio, has put on the market a new steel transmission pole, fabricated from copper steel, which contains new features in design tending to reduce manufacturing costs. The pole consists of two structural steel channels, each of which has the center portion of the web sheared and pressed out normal to the web. Each of the pressed-out sec-

tions forms approximately a triangle, the ideal formation for resisting stress. The depth of the cuts is uniformly graded from top to bottom so that when the two channels are riveted together a tapered pole is formed in which the web members form what is practically a double intersection Warren type cantilever truss. Each web member is curved in the form of a circular arc, thus adding substantially to its ability to resist compressive stresses. The importance of this is evident, since each web member may be subjected to either tension or compression.

The Truscon pole represents the latest data on copper steel for structural uses. For some time it has been known that a small percentage of copper in steel has a tendency to retard corrosion, and steel manufacturers have been conducting a series of practical tests covering many years. These tests indicate that steel containing a proper quantity of copper attains a high rust-resisting quality throughout its whole body without losing any of its other valuable qualities.

The claims made for the Truscon standard steel poles are first their economy, due to their scientific design, resulting in the distribution of metal so that it will most effectively resist pole stresses; second, that the methods of manufacture are simple and capable of a high degree of standardization in the factory; and third, that the use of copper steel eliminates galvanizing.

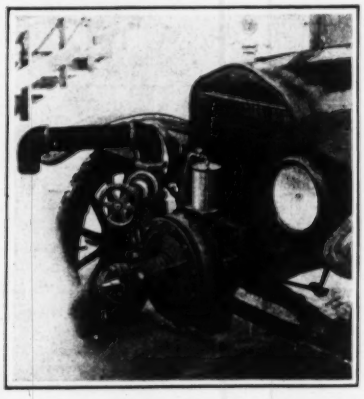
## Chain Block Has Load Sheave Mounted on Ball Bearing

The latest development in the line of chain blocks made by the Yale & Towne Manufacturing Co., Stamford, Conn., consists of the introduction of large-sized chrome vanadium steel ball bearings to support the load sheave, as shown in the accompanying illustration. By the introduction of these ball

bearings it is claimed that the mechanical efficiency of the block has been increased, under full load, over 6 per cent. The top hook, crosshead, suspension plates, load sheave, electric-welded load chain, detachable shackle, bottom crosshead and hook are all steel, so that the load hangs on a line of steel from hook to hook. For all parts that are subjected to tension in sustaining the load wrought steel is employed instead of castings. These chain blocks are being built in sizes ranging from ½ to 20 tons capacity.

## New Pump for Attachment to Motor Car or Truck

The Barton portable pump, recently put on the market by the American Steam Pump Co., Battle Creek, Mich., uses the motive power of motor cars, tractors or trucks by means of a power



take-off that utilizes a floating shaft to connect the pump with the motors.

The pump is of the centrifugal type and is carried on the frame of the car so that it may be left on while driving. It is made in two standard sizes, 2½ in. and 3 in. The 2½-in. pump will lift water about 20 ft., has a normal discharge capacity of 200 to 250 g.p.m. at 18 m.p.h. driving speed. The 3-in. pump has a discharge of about 300 g.p.m.

## *Publications from the Construction Industry*

*Pumps for Handling Oil* — GOULDS MANUFACTURING CO., Seneca Falls, N. Y., has published the report of a recent investigation made for it in collaboration with the Union Oil Co. of California to determine the adaptability of centrifugal pumps for handling oil. In the tests petroleum products ranging from gasoline to oil of 7,000 Saybolt viscosity were pumped. Eighteen charts are given showing the performance of centrifugal pumps when handling these commodities as compared with the performance when handling water.

*Vitrified Clay Sewer Pipe*—EASTERN CLAY PRODUCTS ASSOCIATION, Philadelphia, composed of 18 firms mostly in Ohio and Pennsylvania, has recently issued a booklet, "Tentative Standards," which illustrates and explains the tentative standards adopted by the association for all manner of vitrified sewer pipe fittings and other clay products. The purpose of the publication is to bring to the attention of engineers, architects, and others interested in draining and building materials, the co-operation of the manufacturers of salt glazed clay sewer pipe in the general effort for standardization and elimination of needless varieties.

All the fittings adopted by the association conform in socket design to that adopted by the American Society for Testing Materials as standard specifications for clay sewer pipe. The booklet gives the dimensions of all fittings needed for pipe sewer construction. The co-operation of every engineer and architect in this effort for standardization is solicited, and criticisms and suggestions are invited, both as to the A.S.T.M. standard and the lists of proposed standard manufacture.

*Rollers*—WILLIAM WHARTON JR., & CO., INC., Easton, Pa., has described Wharton seamless drawn steel hollow rollers in an 8-p. booklet. Among the advantages claimed are ease of operation, maximum strength, and superior wearing qualities. One of the types illustrated is that of a return roller for belt conveyors.

*Convertible Crane-Excavator* — BAY CITY DREDGE WORKS, Bay City, Mich., has just published two bulletins. Bulletin 20 illustrates the use of the Bay City Model 16-13 convertible crane-excavator on a difficult piece of sewer construction in Brooklyn, N. Y., and Bulletin 21 goes into detail as to the construction of this equipment with its different buckets, including skimmer, trencher, shovel and clamshell.

*Flue Linings*—EASTERN CLAY PRODUCTS ASSOCIATION, Philadelphia, in its 25-p. bulletin "Flues and Flue Linings, with Related Data on Chimneys and Fireplaces," gives a complete technical résumé of the best current practices. The bulletin is offered in the interest of restraining fire and the products of combustion within lined flues. In addition to giving all standard dimensions for both rectangular and round fire clay flue linings the bulletin contains valuable discussion on the theory and construction of chimneys and fireplaces, with data on size of the flue, throat construction, shape of fireplace, supports for chimneys, smoke shelf and chamber, and architectural chimney tops. Detail drawings of approved installations are given. There is also a specification for brick chimneys with fire clay flue linings.

*Skip Hoists* — LINK-BELT CO., Chicago, in Book 546 interestingly sets forth in text matter and illustrations the functions of the skip hoist and its relation to other types of mechanical equipment; tells where and on what classes of work skip hoists are profitably used, and gives details of operation, capacity, design and construction.

*Excavating Machinery*—OSGOOD CO., Marion, Ohio, tells in its Bulletin 250 about its revolving and railroad shovels, and gives a table of their ordinary working ranges. In Circular 251 is told pictorially how highways are built the Osgood way and in Circular 253 the merits of the Osgood Power Shovel are enumerated.

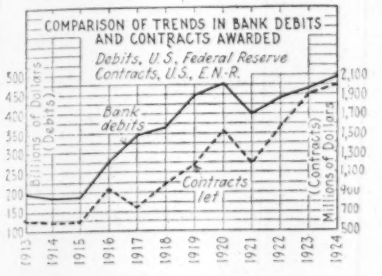
# Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

## The Construction and General Business Trends

### Contract-Letting Slower When Bank Debits Drop—Both on Up-Grade at Present

The similarity between the curves of general business and contract-letting is shown by the chart covering operations over the entire country. The general business trend is shown by the Federal Reserve statistics of payments made by check against accounts of individuals, firms, corporations, etc. The contracts curve is plotted from *Engineering News-Record* statistics.




The only divergence of the two curves is in 1917, in which year money was deliberately diverted from construction and spent for other purposes. Bank debits in this year were 25 per cent more than in 1916. Construction contracts, on the other hand, amounted to 19 per cent less than in 1916. Public works suffered particularly and industrial construction was much less than in 1916 and 1918.

Construction's three set-backs in the last twelve years occurred in 1914, 1917 and 1921. In this period there were two business depressions—at the outset of the war in 1913-1914, and in the post-war deflation period of 1921. Since 1921 both curves have been rising.

## Corporate Earnings Indicate Business Activity

Earnings of twenty-one companies selected at random from the daily press are here tabulated. These returns are for various periods since Jan. 1 and are compared with corresponding periods in 1924.

The list comprises such industries as: Automotive, light, power, traction, transportation, telephone, telegraph, cable, mining, dry goods and chain stores.

Out of the twenty-one listed only one, the Canadian National Railways, developed a loss compared with the same period in 1924. The deficit in this case was 9 per cent.

Gains, however, were spectacular in several instances. The Delco Light Company, a division of the General Motors Corporation, doubled its sales in the first quarter of the current year, compared with those of the corresponding months in 1924. Operating earnings of the Federal Mining and Smelting Co., for the first quarter, were 118 per cent greater than those from Jan. 1 to Apr. 1, 1924. The Nash Motor Company's net income for the three months ending Feb. 28, was 91 per cent greater than that for the same period last year. The Western Pacific R.R. gained 51 per cent; the Carolina Power & Light Co., 27 per cent; the J. C. Penney Co., Inc., 19 per cent.

## This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for waterworks and excavations, $25,000 for other public works, $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

| Week Ending | Public Work | Private Work | Total Contracts |
|---|---|---|---|
| **May 28, 1925** | **$26,533,000** | **$23,853,000** | **$50,386,000** |
| May 21, 1925 | 22,754,000 | 12,298,000 | 35,052,000 |
| May 29, 1924 | 24,429,000 | 19,422,000 | 43,851,000 |
| *Heaviest Week* | | | |
| 1924, May 8 | 26,370,000 | 38,829,000 | 65,199,000 |
| 1925, Apr. 2 | 43,603,000 | 27,633,000 | 71,236,000 |
| *Jan. 1 to Date* | | | |
| 1925 | 407,439,000 | 533,670,000 | 941,109,000 |
| 1924 | 407,846,000 | 481,553,000 | 889,399,000 |

## Average Bid Prices Given on 22 Mi. of Pipe for Water System

An idea of unit costs on the construction of a 22-mi. pipe line for a municipal water system, may be gained from examination of the following tabulation of average bids. The project on which the bids were received is that of the Gordon Valley pipe line for the city of Vallejo, Calif.

FURNISHING PIPE ONLY

| Diameter | Thickness | Price per Ft. |
|---|---|---|
| 24-in. welded steel pipe | ¼-in. | $2.70@$2.72 |
| 22-in. D. riveted steel pipe | ¼-in. | 2.63 |
| 24-in. D. riveted steel pipe | ¼-in. | 2.82@ 2.84 |
| 22-in. welded steel pipe | ¼-in. | 2.45@ 2.47 |

FURNISHING VALVES

| | 1-in. | 2-in. | 3-in. | 4-in. |
|---|---|---|---|---|
| A and V | | $51.00 | $77.46 | $100.81 |
| Air valves | $24.33 | 30.06 | 64.63 | ..... |
| Check valves | 1.66 | 5.35 | ..... | ..... |
| Stop cocks | 1.82 | 4.29 | 10.25 | 20.89 |
| Screw gates | ..... | 3.51 | 5.98 | ..... |

GATE VALVES

| Size, In. | Price | Size, In. | Price |
|---|---|---|---|
| 4 | $13.55 | 14 | $107.59 |
| 6 | 22.45 | 22 | 390.12 |
| 8 | 33.23 | 24 | 383.08 |
| 12 | 64.91 | .. | ..... |

EARNINGS OF VARIOUS COMPANIES, BY PERIODS, SINCE JAN. 1, 1925, COMPARED WITH CORRESPONDING MONTHS LAST YEAR

| Gross Sales, First Quarter | 1925 | 1924 | Per Cent Gain or Loss |
|---|---|---|---|
| F. W. Woolworth & Co. | $45,970,067 | $41,471,238 | + 11 |
| Canadian National Railways | 55,505,951 | 61,126,408* | — 9 |
| S. S. Kresge Co. | 20,769,600 | 18,350,889 | + 13 |
| J. C. Penney Co., Inc. | 14,237,593 | 11,931,445 | + 19 |
| The McCrory Stores Corporation | 5,507,660 | 4,801,512 | + 15 |
| G. R. Kinney Co. | 3,336,618 | 2,921,199 | + 14 |
| F. & W. Grand 5-10-25-Cent Stores, Inc. | 1,425,805 | 1,287,044 | + 11 |
| **Gross Earnings, February** | **1925** | **1924** | |
| American Tel. & Tel. Co. | $6,697,239 | $5,913,974 | + 13 |
| Southern California Edison Co. | 1,828,183 | 1,664,236 | + 10 |
| Brazilian Traction, Light & Power Co. | 2,207,359 | 2,200,534 | + 0.3 |
| Carolina Power & Light Co. | 276,028 | 218,024 | + 27 |
| Federal Light & Traction Co. | 525,400 | 509,710 | + 3 |
| West Penn Co. | 2,284,814 | 2,271,058 | + 0.6 |
| American Water-works and Electric Co., Inc. | 3,427,122 | 3,307,109 | + 4 |
| **Other Periods Since Jan. 1** | **1925** | **1924** | |
| Nash Motors Co., net income, three months ending Feb. 28 | $3,099,293 | $1,618,475 | + 91 |
| Delco Light Co., retail sales value of factory shipments, 1st quarter | 7,100,000 | 3,550,000* | +100 |
| Winnipeg Electric Co., net earnings, February | 132,399 | 121,512 | + 8 |
| Oppenheim, Collins & Co., sales for first quarter | 4,929,304 | 4,709,919 | + 5 |
| Western Pacific R.R. net operating income, February | 127,480 | 84,304 | + 51 |
| All America Cables, Inc., net income 1st quarter | 927,168 | 903,190 | + 3 |
| Federal Mining and Smelting Co., operating earnings, 1st quarter | 1,021,298 | 467,649 | +118 |

* Estimated. (+) Gain. (—) Loss.

AVERAGE BID PRICES ON 22-MI. OF PIPE, FURNISHED IN PLACE, INCLUDING TRENCHING AND BACKFILLING

| Electric Welded | | | | Riveted Steel | | | |
|---|---|---|---|---|---|---|---|
| 22-in., dia. | | 24-in. dia. | | 22-in., dia. | | 24-in., dia. | |
| ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick |
| $423,020 | $461,032 | $458,859 | $488,488 | $457,850 | $481,624 | $484,097 | $510,224 |

FURNISHING AND LAYING PIPE ONLY—NO TRENCHING

| Electric Welded | | | | Riveted Steel | | | |
|---|---|---|---|---|---|---|---|
| 22-in., dia. | | 24-in. dia. | | 22-in., dia. | | 24-in., dia. | |
| ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick | ¼-in. thick | ⅜-in. thick |
| $340,935 | $388,960 | $376,599 | $416,416 | $375'958 | $409,552 | $401,807 | $438,152 |

# Weekly Construction Market

WHILE the general commodities market shows some signs of firmness this week, the same can not be said of building materials prices. In the latter, there are scant possibilities of advances exceeding the declines, so far as the immediate future is concerned.

The five principal price movements of the week were in c.-i. pipe, steel pipe, lumber, hollow tile and common brick. The last two were the only ones to show advances in price.

The decline in c.-i. pipe was quite general, while that in wrought-steel pipe was confined mostly to the West.

Lumber price weakness developed in the South and Middle West. Firmness, with very little change in prices and some improvement in demand, is reported in New York and points North, also in parts of the Mississippi Valley. Lumber demand is running largely to upper grades of flooring, finish, lath, special cutting, railroad material and timbers. Increase in volume of new business is reported by the National Lumber Manufacturers Association. Production is about 14 per cent ahead of a year ago, shipments, 2 per cent and orders 26 per cent.

Improvement in demand is noted in tubular goods, tin plates and steel sheets. Buying is moderate in the iron market with slight improvement in tone. Iron prices remain unchanged with no further slowing down in production reported. Iron and steel scrap is firmer. The minimum on steel shapes and plates is now $1.90 per 100 lb., Pittsburgh; that on reinforcing bars, $2 per 100 lb. This represents a drop of about 10c. per 100 lb. in a week on structurals. The maximum mill quotation of $2.10 per 100 lb. on the principal hot-rolled products, applies mostly to small tonnages.

Among other materials not especially related to construction, firmness is reported in crude oil, textiles and non-ferrous metals. The comparative steadiness of the non-ferrous metals' market is attested by the fact that fabricated products such as brass tubing, copper wire, etc., have not shown any appreciable price fluctuations since the first week in May.

| | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products** | | | | | | | | | |
| Structural shapes, 100 lb. | $3.34 | $3.90 | $4.15 | $3.10 | $3.35 | $3.07½ | $3.30 | $3.35 | $4.25 |
| Structural rivets, 100 lb. | 4.50 | 4.45 | 4.75 | 3.50 | 3.75 | 4.65 | 5.00 | 3.75 | 6.00 |
| Reinforcing bars, ¾ in. up, 100 lb. | 3.24 | 3.40 | 3.38 | 3.00 | 3.25 | 3.87½ | 3.35 | 3.25 | 2.30 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 48% | 53.2% | 43% | 57% | 54.25% | 36% | —39.2@51% | 50% | 59.49 |
| Cast-iron pipe, 6 in. and over, ton | 50.60@51.60 | —54.00 | 56.00 | 46.70@48.20 | 53.00 | 62.00 | —52.00 | —53.00 | 60.00 |
| **Concreting Material** | | | | | | | | | |
| Cement without bags, bbl. | 2.50@2.60 | 2.30 | 2.05 | 2.20 | 2.42 | 2.84 | 2.31 | 2.65 | 1.80 |
| Gravel, ¾ in., cu.yd. | 1.75 | 1.90 | 2.38 | 2.75 | 1.65 | 1.90 | 2.15 | 1.50 | 1.25 |
| Sand, cu.yd. | 1.00 | 1.40 | 2.00 | 2.75 | 1.25 | 1.00 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.85 | 2.00 | 2.83 | 2.75 | 1.75 | 2.50 | 2.15 | 3.00 | 1.90 |
| **Miscellaneous** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 60.00 | —34.00 | 56.00 | 29.00@39.00 | 39.75 | 34.75 | 27.00 | 23.00 | 60.00 |
| Lime, finishing, hydrated, ton. | 18.20 | 22.50 | 20.00 | 20.00 | 25.50 | 24.00 | 22.00 | 24.00 | 21.00 |
| Lime, common, lump, per bbl. | 2.50@2.75 | 1.45 | 1.85 | 1.21 | 1.35 | 2.70 | 1.60 | 2.80 | 2.50 |
| Common brick, delivered, 1,000. | 17@19 | 10.50 | 12.10 | 12.00 | 13.50@13.60 | 12.00 | 15.50 | 15.00 | 17.50 |
| Hollow building tile, 4x12x12, per block. | Not used | .0808 | + .10 | .06 | .... | .085 | ..... | .10 | .12 |
| Hollow partition tile 4x12x12, per block. | .1162 | .0808 | + .10 | .06 | .07 | .085 | .108 | .10 | .10 |
| Linseed oil, raw, 5 bbl. lots, gal. | 1.09 | 1.15 | 1.30 | 1.23 | 1.15 | 1.28 | 1.14 | 1.12 | 1.25 |
| **Common Labor** | | | | | | | | | |
| Common labor, union, hour | .75 | .30 | | .87½ | | .50@.55 | .55 | .62½ | ..... |
| Common labor, non-union, hour | .... | .25 | .30@.50 | .75 | .50@.55 | .35@.50 | .50 | .50 | .25@.35 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

**New York** quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 50c. per hr.

**Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

**Minneapolis** quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

**THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.**

**Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.**

**The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 7, the next on June 4.**

**Denver** quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

**Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

**Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

**San Francisco** quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

**Seattle** quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

**Montreal** quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.